THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 23. Thursday, February 24, 1921. No. 236.

PUBLISHED WEEKLY.

Subscription Terms: 15/- per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

The Foundry Trade Journal.
BESSEMER HOUSE 5, DUKE STREET, ADELPHI, LONDON, W.C.2.

Contents.

	PAGE
Notes and Comments	169
Types of Foundry Buildings	170
American Semi-Steel	172
The Manufacture of Manganese-Bronze Marine Propellers.—Part I.	173
Some New Features in the Rundle Foundry	175
Treatment and Uses of Dolomite	176
The Freeman Precision Temperature Control	177
High Tensile Steel Castings	178
A Crucible Skimming Arrangement	179
Concrete Pipes	179
"Safety First" in Steelworks	180
Oil-Fired Annealing Furnace	181
Open Frames and Closed Plates for Pattern Making	182
Institution of British Foundrymen	183
Trade Talk	188
Company News	189
Obituary	189
Personal	189
British Industries Fair	189
Iron and Steel Markets	190

INSTITUTION OF BRITISH FOUNDRYMEN.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, Bessemer House, Adelphi, Strand, London, W.C.2.
Manchester: J. Hogg, 365, Manchester Road, Burnley, Lancs.
Birmingham: F. B. Holberry, 22, Salisbury Road, West Bromwich.
Sheffield and District: W. A. Macdonald, 62, Button Hill, Ecclesall, Sheffield.
Scottish: W. H. Bound, 5, Midlothian Drive, Shawlands, Glasgow.
London: A. Willis, Norfolk House, 324, South Lambeth Road, Clapham, S.W.
Peterborough: H. P. Mason, Prudential Chambers, Peterborough.
Newcastle-on-Tyne: H. A. J. Rang, 2, St. Nicholas Buildings, Newcastle-on-Tyne.
East Midlands: H. Bunting, 17, Marcus Street, Derby.
Coventry: F. H. N. Lane, Queensberry, 2, Dover Street, Coventry.

NOTES AND COMMENTS.

Wasters.

A perusal of current foundry literature cannot do otherwise than impress upon the reader that all is not well in the British foundry. In the December issue of THE FOUNDRY TRADE JOURNAL an article set forth a strong condemnation of the London casting. Recently papers given before the Birmingham and Lancashire Branches of the Institution of British Foundrymen have brought to light that similar conditions also exist in these districts. We may assume therefore that imperfect castings are now general throughout the industry, with naturally a fair number of brilliant exceptions. Light malleable iron castings have recently been very severely criticised, it having been asserted that 25 per cent. are *prima facie* wasters, which figure is considerably augmented by rejections from the machine shop. As Mr. Sherburn points out on page 185, foundrymen are far too prone to dismiss the subject by blaming bad coke and bad iron. We can assure our readers that no similar excuse would be accepted in the steel industry, and we are convinced that suitable raw materials are available in this country, provided the necessary attention is given to their judicious mixing. We recently had demonstrated to us that, using normal common sense good hot cupola metal could be brought down with a ratio of 1 cwt. of coke to 18 cwts. of pig and scrap. Naturally such a consumption is not without influence on the sulphur absorption. It is evident, therefore, that the conditions now obtaining call for the most drastic remedy. Every foundryman should insist on knowing the average composition of every charge sent up to the cupola charging platform or weighed out for the crucible. We are convinced that if a serious reduction in the present high percentage of wasters could be effected, the cost of means to establish such conditions would be negligible. Naturally, by co-operative methods, foundrymen could arrive at a point where the composition of all foundry materials would be definitely established by the cheapest means. If the British Cast-Iron Research Association gets the necessary support from the trade the stigma now existing should be largely removed.

We have no fear that the foundries, who in the past have adopted the latest methods, will not take up a "dog-in-a-manger" attitude, and assert that having established themselves by their foresight in a position more favourable than their smaller competitors, they can safely "rest on their oars." They are only too cognisant of the value of research, and no doubt are aware of the case of the American foundry which for a time kept aloof from their research association, but which eventually through sheer necessity became its most ardent supporter.

The Foundrymen's Competition.

We would remind competitors that only one week remains in which to submit essays. All matter must reach us by March 3.

The British Cast-Iron Research Association.

We are asked to announce that permanent premises have been secured for the Association at Central House, New Street, Birmingham. The telegraphic address is "Cira, Birmingham."

THE FOUNDRYMEN'S COMPETITION

FIFTY GUINEAS IN PRIZES FOR BEST DESIGN AND EQUIPMENT OF A FOUNDRY.

To mark the change over of the FOUNDRY TRADE JOURNAL from a Monthly to a Weekly publication, the Proprietors have pleasure in announcing that they are offering two Prizes of Thirty and Twenty Guineas respectively for an article dealing with the subject of the design and equipment of a Foundry (ferrous or non-ferrous), with special reference to the latest labour-saving devices and machines, internal transport and handling tackle

Competitors, by submitting articles, signify that they adhere to the following rules:—

(1) Competitors must be in the employ of an established British foundry subscribing to the FOUNDRY TRADE JOURNAL, or himself a subscriber.

(2) Articles must be illustrated with dimensioned drawing and sketches.

(3) The copyright of all papers and designs accepted for publication will become the property of the Proprietors of the FOUNDRY TRADE JOURNAL.

All papers must reach this office by Thursday, March 3rd 1921. The decision of the Editor will in all cases be final.

Types of Foundry Buildings.*

Whilst the subject is not of primary importance, it may claim to deserve more careful attention than it has hitherto received if it is desirable to secure increased efficiency, and to eliminate some of the acute discomfort under which many foundrymen work. The matter has received some attention, which, however, is slight compared with the consideration given to the subject in many other industries during the last fifty years. A large number of factors have operated to bring this about; the generally increased size of machinery, tools, and higher powered appliances have set up strains and stresses which the buildings hitherto used were not designed to resist.

In some industries buildings have been left derelict or used for some other purpose, as they were no longer capable of meeting the increased requirements. The relation and sequence of various operations has also affected the general design. The efforts in this direction have met the requirements in a way which leaves little to cavil at as far as the buildings are concerned. Since steel was introduced for structural purposes there has been a constantly increasing tendency in favour of its use, and numerous varieties of design have been tried in the engineering industry for standards, floor and roof trusses. Wherever the area available is large enough, the one-floor type of works is most in favour.

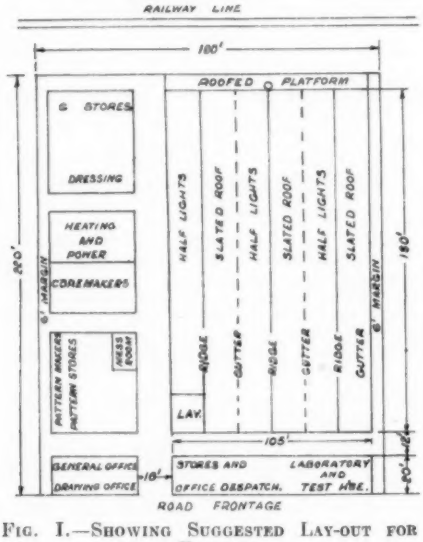

FIG. I.—SHOWING SUGGESTED LAY-OUT FOR A FOUNDRY.

The founding industry has the distinction of having (in this country at least) a greater variety of buildings at its service than any other class of work. Almost any kind of building, even if it is not all that could be desired, is considered worth using. Perhaps the fact that the personal element and some degree of craftsmanship is essential for the successful execution of foundry work, even of a mechanical nature, does to some extent overshadow the need of suitable accommodation. Quite a number of basements and small temporary buildings are in use, and much good work has been turned out of them. Of course, the "Public Health" and "Factory and Workshop" Acts exercise some influence over the hygienic and sanitary conditions, but they leave something to be desired.

The extending requirements of engineers during the last few decades have led to the creation of larger and newer types of buildings. In many cases where foundries have been built in connection with new works the foundry has shown little variation of design from the machine shop and other sections, except with respect to floors, artificial heating, ventilation and finish. However, several attempts have been made to meet the requirements of the industry, but owing to their varied nature these are not a uniform type or model. That type which provides suitable accommodation adequate to meet probable requirements, and which provides facilities for the due sequence of operations and eliminates useless handling, is no doubt what most foundry designers have in mind.

What is probably the oldest type in use is the hall type, usually between 120 ft. to 200 ft. long and 40 ft. to 60 ft. wide, lit partly from the roof and high wall-lights, and between 35 ft. to 50 ft. from floor to ridge; very often the foundry floor is excavated, making it possible for the iron to be taken to the charging platform without the use of a hoist. However, with the rise of mammoth engineering works in connection with transport, public services, etc., larger foundries have grown up, and some attempts were made to provide suitable accommodation for moulders, coremakers, dressers, stores and other activities which were successful in promoting the efficiency of the whole. One of the defects of the larger foundry was the tendency to compress as many operations as possible under one roof or series of roofs.

In this country there is a mild, humid atmosphere and a short range of temperature variations, and extremes are of rare occurrence, so that elaborate precautions in respect to weather are not required as they are in many other countries.

The types of foundries may be classified in four groups:—(1) The hall type referred to; (2) the group or one-roof (or series of roofs), foundry; (3) the shed type; (4) the segregated type. The first type, usually built when the near vicinity of rail service was lightly thought of, is dying out, although it had several features entitling it to respect.

The second is simple in principle, and is suitable for a small or growing foundry, as it may be extended, if ground is available, with little difficulty. With north lights, small ridge ventilators, supplemented by lattice wall-ventilation and between 12 ft. to 14 ft. from floor to gutter, make this type a comfortable shop to work in, if the width is not more than 60 ft., provided that all metals that fume and furnaces which give off a lot of smoke are built in annexes.

The third type is usually utilised where work of a large and extensive kind is carried out, and its dimensions vary from 300 to 700 ft. in length and about 200 ft. in width. It is flanked with lower roofed buildings for minor operations. This type is usually lofty to accommodate cranes and other mechanical devices. There are, however, smaller works which use the one-roof system, general stores, patternmakers, and pattern store moulders, coremakers and dressers being all provided for under one series of roofs, small partitions separating some of the workers.

The fourth type is one which groups the various departments in separate buildings, giving particular care to the needs of each section and its relation to the common purpose, *i.e.*, the production of high-grade castings. The lecturer hoped the competition organised by THE FOUNDRY TRADE JOURNAL will furnish some ideas on this matter, and, despite the relatively high cost of construction, will produce a type of the most perfect efficiency and healthy shop conditions for the workers.

The lay-out, shown in Fig. 1, was submitted for providing a base for discussion.

DISCUSSION.

MR. PRICKETT observed that no accommodation had been allowed in the author's sketch for workmen's clothes and washing arrangements. He noticed that a messroom had been mentioned, but this had been placed some distance from the workshop, therefore other accommodation also should have been included.

MR. CORDEN, referring to ventilation, thought they could have windows placed in the walls of the foundry, but connected to the roof, for opening purposes, which could be easily manœuvred.

MR. A. HARLEY said that Mr. Whitworth was to be congratulated on his attempt at foundry design. There were one or two defects and imperfections in the lay-out, but, on the whole, the author's plan was very good. Someone had remarked how very different the design of foundry

* Paper read at the February meeting of the Coventry Branch of the Institution of British Foundrymen.

buildings would be if left to the workmen. He, himself, as a foundry manager, had spent many happy hours designing an ideal foundry. But his ideal was always very different from the foundry he was allowed to build. They could put on paper what they thought, but when they went into the question with the proprietors, many considerations not previously thought of crept in and they had to start modifying the design, so that by the time they had finished they hardly knew the lay-out they had originally designed. The great difficulty in designing was the fact that the various classes of work required different lay-outs. On the whole he thought they had better stick to something modest, such as Mr. Whitworth had designed. The first thing that should receive attention was solidity of the foundations; they must build on good ground. With regard to the lighting of a foundry, he believed that the general consensus of opinion was that roof lights were the best. These should be supplemented by a certain amount of side wall lighting where possible, high up the roof from the north. This would be quite easy if the glass could be kept clean. With roof lighting, furnaces which gave off fumes should be kept in a separate part of the building or means adopted for taking the fumes away. He did not quite understand one or two points about the roofing of the building. There were three beds shown on the diagram, but he was not quite sure whether it represented a continuous roof from north to south or whether it was a saw-tooth edge.

Mr. Whitworth: Three gable roofs—continuous beds from end to end.

Mr. Harley, continuing, said that of course a great many things had not been mentioned, but he thought that in a foundry of that size it was very important not to have the stores put away in a back corner. After all, most of the material came in through the front gate, and it was just as convenient to have the stores in the front as at the back. The general stores should be accessible. With regard to ventilation, he did not quite understand what was meant by a lattice roof, and wondered whether a Louvre roof was referred to.

Mr. Whitworth: A lantern roof is meant.

Mr. Harley further said that he had come to the conclusion, after having tried a great many different methods, that nothing could be better than well-designed Louvre roofs. Naturally, the great trouble in trying to force ventilation through the ends or the side walls was that so many parts had to be kept open, and invariably the ventilation was short-circuited. Returning to the question of floors, Mr. Harley said that having got a solid ground, when dealing with light castings there was nothing superior to blue bricks. He thought that a blue-brick floor was very compact, and one advantage was that they could remove a few bricks without trouble. It was very difficult to criticise a lay-out at short notice. One conclusion he had come to was that where there was a large output of different metals, he would insist on having separate foundries. It was not desirable, he thought, that such different metals as cast iron, steel, and gun-metal should be treated in the same shop, owing to the danger of getting the metals mixed. Perhaps, as most of the fumes in a brass foundry came from the brass furnace, they would require something stronger than Louvre ventilation.

With regard to the pattern shops and storage, he had come to the conclusion that a separate building was required. Unfortunately, most heads of firms were much against separate buildings, and that had been one of the difficulties he had been met with. In the case of large factories, a special lay-out was necessary; having the foundry buildings altogether, and a special building for the pattern-shop and stores was absolutely essential. The best type of building for the purpose, he considered, was one of two storeys, with the pattern-maker's housed above, utilising the ground floor as a pattern storage. The building should be in a position safe from fire, since they all knew what a disaster it would be if the pattern stores got on fire. Mr. Harley then referred to the American system of having a number of floors with a different department of the foundry on a different floor. With regard to general storage, apart from the pattern-shop to which he had specially referred, he certainly believed in one storey, with everything on one floor.

The question of heating a foundry was a real difficulty. Undoubtedly an unheated foundry was a most cheerless place on a wintry morning. That was against efficiency, as a man could not give of his best under such conditions. As to the two cupolas, the reason for having two, he thought, was simply that in case of breakdown they had a reserve. There was another advantage in having two cupolas. When ganister had to be used, it should be dried for 24 hours in the cupola.

The handling and transport of material in the foundry was perhaps one of the biggest problems they had to deal with, as it had to be done with the least expense. Referring to trolley tracks, he would warn them never to sink the tracks into the floor. If they must have a trolley track, space must be provided for it, it must be a proper rail, and should stand clear of the floor. Personally he preferred an electric overhead travelling crane.

He would adopt means whereby the fitting would be done at one end of the foundry. He would leave one gable end for extensions and so arrange matters that the crane could take a casting straight into the fitting shops. He had seen the system at work and considered that it saved money.

As far as the position of furnaces was concerned, in very large foundries there was something to be said for placing them at the side, and if there were likely to be extensions, nearer one end than the other so that eventually they would be more or less in the middle. Another reason for favouring the sides was that generally the length of the foundry was greater than the breadth, and as storage of pig-iron and coke was essential and they had to keep it at one end of the foundry, it would result in congestion. Whilst the design under discussion was not perfect, it showed that Mr. Whitworth had ideas, some of which were very good.

A MEMBER remarked that Mr. Harley's scheme of heating with pipes had been attempted in a Coventry shop but had proved a failure.

Mr. Harley, in reply, said that it could be made a success as it was already successful in the machine shops.

THE BRANCH PRESIDENT said that there was no doubt that foundry buildings had made considerable progress during the last twenty or thirty years. At the present time basement foundries were few and far between. With regard to the author's lay-out, Mr. Whitworth had mentioned a place 20 ft. wide at the end of the foundry for the storage of coke and pig-iron for the furnaces. That would hardly meet the requirements. Considerably more room would be wanted than that mentioned. He agreed with Mr. Harley that stores should be kept as near the entrance as possible, and he would suggest that further room should be found for the examination of castings before discharge. The introduction of a well-lighted shop for examination purposes would add to the value of the lay-out. Like Mr. Harley, he thought that on the whole what Mr. Whitworth had suggested was a very good arrangement. With regard to the foundry floor, in iron shops, particularly where work had to be moulded in the floor, sand was essential, but for lighter work a blue brick floor would show a saving. Mr. Harley had given reasons for the use of two cupolas. Another was that it was often essential that the cupola should be lighted early in the morning. A second cupola saved the pourer the necessity of getting in a hot furnace for the purpose of cleaning out. The linings would also be given a chance to harden more naturally.

THE AUTHOR, in reply, said that sanitary requirements generally needed a great deal of attention. He cited a case where workmen had a five minutes' walk, with the result that the arrangements were seldom taken advantage of. Quite a number of the foundries built since 1905 had a small wall light let in all round the sides with a view to letting in fresh air. These lights were generally 9 ft. from the ground, but, unfortunately, if they wanted ventilation they had to break the glass. Most cores were better when they received the least handling, and would be better if they were made nearer the place in which they would be used. He was of the opinion that cores which were subjected to the varying temperatures of the foundry decreased in value.

XUM

American Semi-Steel.*

Under the title, "Semi-Steel Tests" some interesting data were recently prepared and given out by the metallurgical department of the American Radiator Company.

Constitutionally, semi-steel may be classed as "low-carbon cast iron"—steel being used in the capacity of a ferro-alloy to accomplish the desired results. Strictly speaking, an "alloy" is used in a mixture to add a desired element, to flux an undesirable element, oxidise or neutralise certain harmful gases and residual oxides. In the case of semi-steel mixtures, scrap steel is used as an "alloy" to reduce the percentage of certain elements—silicon (total), carbon, sulphur and phosphorus—and thereby impart to the metal certain characteristics through the ultimate form of carbon-alloys.

About 2 per cent. total carbon is generally recognised as being the separating line between the characteristics of steel and cast iron. However, a cast iron which would closely approach such a total carbon would have a very limited demand to supply, on account of its extreme hardness and brittleness. Total carbon of about 2.80 per cent., with other elements well regulated and balanced, practically marks the safe limit of carbon reduction for serviceable cast iron which has to be machined.

In good quality semi-steel it is necessary to reduce to comparatively low limits the total carbon and silicon, and yet have the casting maintain the machinable nature of grey iron. The strengthening qualities low the tendency of the ultimate carbon-alloy is toward the combined state. Therefore, as the carbon lowers and there is a tendency to chill the casting, the silicon may be raised without detriment to the combined carbon, provided due care is given to the matter of uniformity of cooling rate. The phosphorus should be kept low for strong and tough castings. Manganese may range from 0.45 to 1 per cent., depending on the size and nature of the casting. The sulphur should be kept between 0.07 and 0.11 per cent. in small, medium and heavy castings.

To produce satisfactory semi-steel castings and to ensure uniform fusing and intermixing of pig-iron, cast scrap and steel scrap, a clear understanding should be had as to the proper kind of pig-iron and cast and steel scrap best suited for this class of work, and the correct proportions it is safe to use. The pig-iron should be low in phosphorus—0.25 to 0.50 per cent., depending on the size of the casting; manganese, 0.80 to 1.25 per cent.; sulphur, under 0.05 per cent. The silicon content may be selected with reference to the character of the cast scrap available for use. Silicon 2 to 2.50 per cent. will usually cover all requirements. It is more desirable to purchase a pig-iron which carries sufficient manganese than to resort to the use of ferro-manganese. High-grade agricultural or machinery scrap of low-silicon content (1.75 to 2 per cent.) is desirable, provided sufficient shop or remelt scrap is not available. If very low silicon should be desired in a casting, from 10 to 12 per cent. of car-

TABLE I.—*Tests on Semi-steel.*

	Per cent. steel.	Si.	S.	P.	Mn.	Total	Tr'nsv'rse strength, Tons.	Tensile strength, tons.
No. 1—Grey iron	0	1.85	0.060	0.500	0.800	3.78	1.0	—
Semi-steel	15.0	1.86	0.070	0.430	0.860	3.81	1.4	—
No. 2—Grey iron	0	1.76	0.062	0.488	0.530	3.63	1.1	9.9
Semi-steel	12.5	1.77	0.069	0.339	0.490	3.43	1.3	14.1
No. 3—Grey iron	0	1.85	0.070	0.520	0.530	3.75	1.0	—
Semi-steel	30.0	1.65	0.070	0.450	0.470	3.25	1.6	16.4

	Per cent. steel.	Si.	S.	P.	Mn.	Total carbon.	Tr'nsv'rse strength, Tons.	Impact.
Stark—No. 1	35.0	1.33	0.121	0.194	0.45	3.20	1.4	22.5 in.
No. 2	35.0	1.35	0.121	0.208	0.45	3.20	1.58	24.0 in.
American Radiator Co.—								
No. 1	25.2	1.04	0.118	0.100	0.76	3.22	15.8	19.5 in.
No. 2	21.9	1.61	0.119	0.120	1.10	3.11	16.8	16.5 in.
No. 3	23,3	1.43	0.110	0.112	0.58	2.86	20.0	20.0 in.
No. 4	33.0	1.10	0.109	0.108	0.64	2.84	20.9	18.0 in.

of semi-steel must depend on the proper balancing of the sulphur, phosphorus and manganese. These factors, together with the lowering of silicon, must have their bearing on keeping the graphitic carbon comparatively low (2.40 to 2.45 per cent.) and the flakes broken down to a small size. The combined carbon should range between 0.75 and 0.80 per cent. The rate and uniformity of cooling will also have a direct bearing on the size of graphite flakes.

The successful and scientific mixture of steel scrap with pig-iron and cast scrap in the cupola has been so misunderstood and abused that there would seem to be a call for standard "semi-steel" specifications. The writer submits to the foundrymen for their consideration the following minimum requirements to be approximated in the manufacture of semi-steel castings :—

	Per cent. steel.	Tr'nsv'rse strength, tons.	Tensile strength, tons.
Light castings ..	15 to 19	1.4	14.2
Medium castings ..	20 to 29	1.5	15.1
Heavy castings ..	30 to 40	1.6	16.5

The control of chemical mixtures is of prime importance, linked very carefully with cupola control. In the matter of strength, of course, it should be the aim of the foundryman to reduce the total carbon and silicon; but this practice will be largely controlled by the size of the casting to be poured. The silicon will yield more readily to control than the carbon, from the fact that its oxidation is more or less uniform while the carbon loss or gain through the cupola is more uncertain. As long as the total carbon is kept

wheel scrap may be used to good advantage. Low carbon or soft steel is preferable—such as plate, structural, agricultural, railroad and machinery steel castings. Steel rails, especially smaller sizes, may be used with good results. High-carbon steel, wrought iron and malleable scrap are considered undesirable.

From 15 to 40 per cent. of steel scrap may be safely used in mixtures, depending on size of castings, etc. Very light, corroded or pitted steel should not be used. Steel should be charged on coke bed, followed by the pig, and finally the cast scrap on top. Internal combustion pistons should be made of like material so as to insure their holding compression at all engine temperatures and prevent either a binding effect on expanding or a flapping effect on contracting. Piston rings should be of the very best material so as to prevent leakage of fuel into the crank case, thereby diluting the oil. Bronze and aluminium bearings expand and contract easily, thereby producing a binding or "pinching" of the crank-shaft. Bearings, backed up with cast iron, which varies almost exactly as the steel crank shaft, allow uniform bearing clearance at all temperatures and engine speeds. All of the above conditions may be ideally met by the use of semi-steel castings, and they are very generally in vogue. In fact, the manufacture of cylinders, electrical castings, machinery and all high-duty castings is gradually being turned over to semi-steel specifications.

The first three tests were made by Evans, Diller and Dyer, and, to the author's mind, the poor showing of transverse strength in tests Nos. 1 and 2 is due to the high total carbon. This is borne out by the Stack and American Radiator Company's tests on shell mixtures, shown in Table I. :—

The significance of these tests may be better grasped by the foundryman and purchasers of castings when it is borne in mind that ordinary cast iron will stand an impact test of only 13 to 14 in., while the American Government specifications call for a minimum of 18 in.

* Extracted from an article by J. A. Dyer, which appeared in a recent issue of The Iron Age.

The Manufacture of Manganese-Bronze Marine Propellers.—Part I.*

By W. Lambert.

The modern high-class marine propeller, as produced to-day by the few firms specialising in this class of work is recognised by marine engineers who are competent to pass an opinion to be an engineering product, the manufacture of which demands considerable technical knowledge and skill. Apart from the actual design and supervision during manufacture, the best talent of the pattern maker, the moulder, and the mechanic is requisite to ensure the production of a high-class propeller.

It is a matter of history that the British Admiralty, following the adoption of high-tension manganese-bronze by the principal shipowners of Great Britain, decided, after a series of trials, that henceforth all propellers for the Government service should be manufactured of manganese-bronze, and at the same time introduced the Admiralty Specification requiring tests not hitherto attainable by the use of the older and well-established "Admiralty gunmetal."

The high-tension bronzes as represented by those alloys having a copper-zinc basis compounded with small percentages of other metals such as manganese, tin, iron, aluminium, nickel, etc., and commonly known as manganese-bronze—constitute the series of alloys from which the majority of high-class propellers are manufactured. But two other non-ferrous metals, in addition to "Admiralty gunmetal," are used occasionally for the founding of propellers, namely, aluminium-bronze, and Monel-metal. The former has a copper-aluminium basis, the latter a copper-nickel.

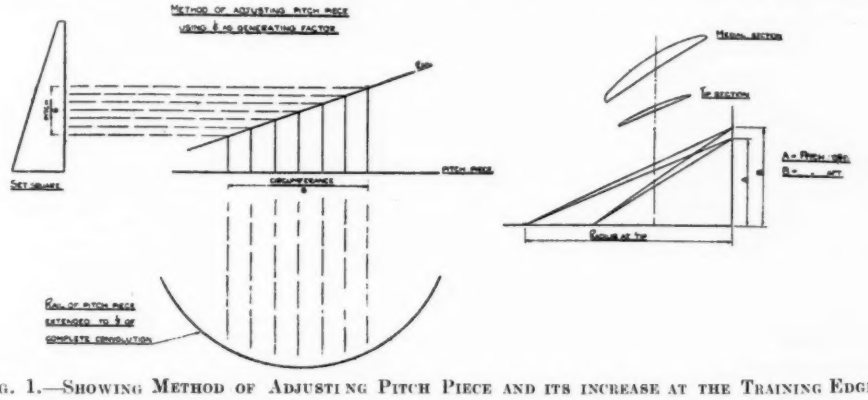

FIG. 1.—SHOWING METHOD OF ADJUSTING PITCH PIECE AND ITS INCREASE AT THE TRAINING EDGE.

Aluminium-bronze, although rarely used, has found a certain amount of favour with some shipowners; but its use has necessarily been very restricted on account of its relatively high cost and of the difficulties attending the successful founding of the metal. Monel-metal—so named after Dr. Monel, of the Nickel Corporation of Canada—is smelted direct from the ore, and has been employed in the manufacture of propellers for a limited number of ships in the United States Navy; but, so far as the writer is aware, Monel-metal has not been proved to possess any material advantages as a propeller metal.

Manganese-bronze more truly belongs to the series of alloys called "brasses." High-tension brass is the designation actually given in the British Admiralty specification; and one must perforce admit the correctness of the nomenclature, limiting the term "bronze" as applied originally to those alloys having a copper-tin basis. However, the name manganese-bronze has become so established by long usage, that throughout this paper the names "high-tension brass," "high-tension bronze" and "manganese-bronze" will be synonymous.

The successful compounding of a high-tension bronze, as used in the manufacture of a modern high-class marine propeller, can only be accomplished through the skilful and systematic examination and control by chemical and micrographical analysis. The works laboratory should include chemical, physical, and mechanical departments.

The recently erected propeller department at the Charlton Works of Messrs. J. Stone & Company includes the drawing-office, pattern-maker's shop, store-house, foundry, fettling, machine and finishing shops, etc., constituting the finest works wholly constructed for this speciality to be found throughout the world. Solid propellers in high-tension bronze weighing 30 tons apiece as cast can be manufactured without difficulty. The furnace drying-stove, machine and crane capacity is designed to deal efficiently with work of this tonnage. Ample floor space in the foundry, several drying-stoves of big capacity, and a battery of large reverberatory melting-furnaces, facilitate expedition in carrying out the founding of work of this large size.

It has not been found practicable to adopt any one standard propeller-bronze to meet the requirements called for by the several classes of propeller-driven ships. The high-speed direct turbine-driven propeller, with wide blades and thin edges, necessitates the employment of a very stiff metal, even at the risk of probable breakage by shock, whereas for small tramp steamers with low-speed reciprocating engines a ductile bronze is preferred for the propellers, as such a metal is difficult to fracture, and if bent can be easily straightened.

The character of the principal types of manganese-bronze employed by Messrs. J. Stone & Company in the manufacture of solid propellers and blades is shown in Table I.

TABLE I.—*Showing tensile tests on various types of bronze.*

Type of bronze.	Max. stress tons per sq. in.	Elongation % on 2 in. lengths.	Microstructure
1	40—42	20—25	all beta
2	36—38	30—35	alpha beta
3	33—35	25—30	alpha beta
4	32—34	25—30	alpha beta
5	30—32	30—40	alpha beta

The following notes dealing with the manufacture of marine propellers in high-tensile bronze, although, in general, applicable to other alloys than manganese-bronze, have been written as particularly representing the practice when the latter metal is used exclusively.

With rare exceptions, the customer's order to the manufacturer for a large solid propeller or loose blade is simply accompanied by a blue print and specification. Casting patterns, as commonly understood, either in wood or metal, are seldom supplied for large work of this class, and, owing to the cost of making such patterns, it is customary in a well-equipped works to do without, and to "strike up" the moulds in loam in the manner described later.

(Small propellers or blades for which a wood or metal pattern has been furnished are generally moulded in sand in a suitable box. This class of

* Paper read before the Institute of Marine Engineers Incorporated.

work closely follows the usual practice of pattern moulding. The mould is "rammed up," and after withdrawal of the pattern is then stoved until dry. The interior surfaces of the mould are subsequently washed with a graphite-wash and thoroughly dried off, either by restoving, or by heat applied locally. The mould is then assembled ready for casting.)

Pattern-Making Department.

All the necessary data—dimensions, curve radii, etc., are given in the specification drawing. From these data the pattern-maker can draw a full-size elevation of the blade and the boss or the blade and the flange, as the case may be; and he can construct accurately all the pieces of apparatus required, which are enumerated below.

Full-size Elevation Drawing.—The elevation is set out on a suitable board, by use of a contraction-rule for iron, gun-metal, or manganese-bronze, which are found to require a contraction allowance of 1-10 in. to the foot. The contraction-rule is not, however, used in drawing the thicknesses of blade sections which have special allowances. This full-size elevation enables the pattern-maker to test the accuracy of the striking-board, boss-board, section-pieces and pitch-templates before sending them to the foundry.

Pitch-Piece.—This consists of an adjustable curved construction. It has a strong wooden base, with right-angled uprights supporting an inclined rail, usually made of teak or mahogany—the whole piece being firmly bolted together. The rail is so mounted as to correspond with the pitch, that is, its upper face traces a portion of the helical curve, at a known radius of the propeller to be manufactured. The radius of a pitch-piece depends upon the diameter of the screw to be constructed, and it is advisable to have a stock of pitch-pieces with various radii.

In adjusting the inclination of the rail it is necessary to use a common factor of both pitch and circumference; this factor is usually 1-6, because thus the radius cuts off a segment containing approximately a sixth part of the total circumference. Thus, if the pitch be 12 ft., the rail will rise 2 ft. in moving round one-sixth of the projected circumference of the pitch-piece; this inclination is adjusted by means of a set-square of a height of about one-third of pitch, and marked off according to the above factor The length of the rail is usually a little more than that of the pitch-piece diameter; for example, if the radius be 5 ft., the rail will extend from 10 to 12 ft., thus allowing ample bearing for the edges of the mould, as shown in Fig. 1.

If a blade has a varying pitch, it can be allowed for according as the variation is from leading to following edge, or from root to tip. If the former, the line of demarcation usually lies along the centre line of the blade, and this may be adjusted on the pitch-piece; if the latter, a supplementary striking-board hinged to the main board at the point where variation begins, may be used, running on a supplementary pitch-piece of lesser radius; or else the bed of the mould must be knifed away or built up by templates to the required pitch.

Striking-Board.—This is the piece of apparatus which generates the helicoid surface, and is shown in Fig. 2. It consists of a board, to which a metal striking edge is fixed, and extends from a spindle (representing the propeller axis) around which the board revolves, to a distance about 6 in. beyond the rail of the pitch-piece; this extra length of 6 in. gives additional leverage to the moulder. The board is suitably reinforced by a strong girder of hard wood to prevent sagging or warping, and the striking-edge is notched or dentelated to mark the position of the sections on the bed—notched for zinc section-pieces, dentelated for wooden section-pieces. A bracket, fitted with a metal roller, is attached to the board, the roller running upon the rail of the pitch-piece; worn rollers must never be used as they cause small but very troublesome variations in pitch. The striking-edge is usually 1-16 in. iron or mild-steel plate; great care must be taken to ensure that the striking-edge is absolutely radial to the centre of the spindle. In some rare instances the centre-line of a blade is set off from the centre of the spindle and the centre-line of the flange, running parallel to the radius. In such cases a wooden block of the required thickness is placed between the board and the arm of the bracket which works on the spindle.

The top of the striking-board should be quite parallel to the striking-edge, so that a spirit-level may be used when bolting the board to the bracket-arm at right angles to the axis of the spindle. Sometimes a blade has a "drop," that is, its centre-line forms an angle of less than 90 degrees with the axis of the screw, looking aft; this "drop" is designed to shorten the length of shaft between the propeller and the ship's counter, so that blades of large radius can work at safe distance from the curve of the stern. In such cases the striking-board has a corresponding inclination, so that a conical helicoid surface is generated. The drop of the board may be tested by the use of a spirit-level supported on a wooden template cut to the angle of inclination.

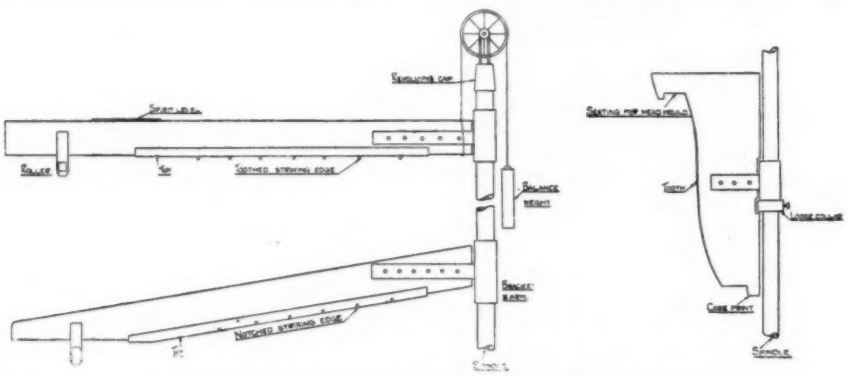

FIG. 2.—SHOWING TYPICAL STRIKING AND BOSS BOARDS.

Boss-Board.—The striking-board for the boss is not shaped to represent the finished contour of the boss, because it would be impossible to cast such a shape without risk of unsoundness in the metal. The striking-edge is wood, not metal; and it is fitted with a small iron tooth, which cuts a groove meeting the centre-lines of the blade. The boss-board marks out part of the head, the upper part of which is provided for by a separate cylindrical mould. It should be noted that the top of the board must always be its maximum radius.

Section-Pieces.—These are made either of zinc-sheet or of wood. Their dimensions are determinable from the drawing, but certain very important allowances have to be made, including those for shrinkage, machining, distortion, and thin edges.

Flange-Pattern.—This concerns blades only. The pattern is made of wood and resembles a segment of a solid sphere based on a thick disc: the bolt-hole recesses are cut away as required. It is made with due allowances for machining and shrinkage.

Templates.—Pitch-templates are used for correcting pitches at various radii, or for testing any variations due to cutting away or building up. They are constructed on the principle that the helical angle increases from the circumference to the centres where it becomes 90 deg. A spirit-level is used to test their position on the bed of the mould. Tilt and fillet-templates of wood for the correct building up of tilt (which is designed to facilitate the flow of water from the root face of a blade), or for the cutting away of fillets, where the blade meets the boss, are made to the radii of curves as

given in the design print. The radii of fillet curves are least towards the edges of the blades and greatest towards the centre-lines.

Core-Boards.—Large propellers are always cast with cored bosses. The dimensions of the core are fixed by the pattern-maker, and a striking-board of wood is constructed to enable a suitable core to be struck up. Propellers of less than 5 ft. diameter are usually cast with solid bosses. The core tapers from the bottom of the mould upwards, that is in a direction opposite to the taper of the finished shaft-hole; the core is made as small as conveniently possible, and tapered upwards to facilitate the flow of metal to the blades. "Lightening-chambers" in a boss are, if possible, to be avoided, because they prevent the adequate "feeding" of the metal to the blades.

To be continued.

Some New Features in the Rundle Foundry.

Some details of a cupola charging device and a sand throwing machine which replaces moulding are given in a recent issue of the "Iron Age."

One of the difficulties encountered in designing cupola charging equipment is to secure an even distribution of the coke and metal. The machine at the Rundle plant differs radically from previous designs. It consists of a cylindrical bucket with a loose bottom in the shape of an inverted cone. When the bucket is to be discharged, the bottom is lowered while the cylinder remains in a fixed position, and the coke or metal slides off the cone to all sectors of the cupola. To insure a tight fit between the bottom and the bucket proper when closed, a band has been riveted on the outside of the bottom circumference, and the circumference of the cone has been provided with a depressed rim. The rivets in the bucket are countersunk on the inside so that no obstruction is offered to the easy movement of the contents.

The bucket is suspended by hoist from the arm of a Pawling & Harnischfeger 3-ton monorail crane. A stop is provided on the exterior of the cupola so that when the arm of the crane strikes it the suspended bucket is exactly centred in the shell. The bucket is 36 in. in diameter (18 in. less than the interior of the cupola) and has a capacity of 2,000 lbs. of pig-iron and scrap. Because of its design the bucket in discharging will not result in wearing the lining of the cupola at any one point; such wear as takes place is evenly distributed around the entire circumference. Coke charged by hand is thrown in from the charging floor and when the bed is low, the fuel is apt to be broken and pulverised by the impact. When the charging machine is used, however, the bucket is lowered for discharge to a point just above the last material charged, no matter what may be its level.

The charging bucket is equipped with three castors so that it can be moved about on the floor by hand. This will prove particularly advantageous for moving charges of coke to the charging room, as the coke storage is on the same floor.

The cupola itself is of interest, the area of its cross-section above the charging floor level being considerably greater than below. The purpose of increasing the inside diameter in this manner is to arrest the ejection of sparks, cinders, and iron particles which ordinarily drop on the roof and fill up the roof drains. The cupola was furnished by the W. W. Sly Manufacturing Company, Cleveland. Blast is furnished by a belt-driven P. H. and F. M. Roots Company blower, having a capacity of 38.5 cub. ft. per revolution. The blower is placed on a mezzanine floor.

The facilities provided for handling coke, pig-iron, scrap, sand and clay from cars to foundry are worthy of attention. The stock yard, which lies between the long side of the foundry addition and a railway siding, consists of a double row of bins divided by a covered depressed track which carries an electrically operated scale car. The bins are all designed to hold a car-load of pig-iron, and those for purchased scrap, which are located next to railway siding as contrasted with the company scrap bins which are on the other side of the scale car track, have a capacity of 175 tons each. In unloading, labourers transfer the pig-iron from the truck to a portable roller conveyor, placed between the car and the bin, over which the material slides by gravity to storage.

In the stock yard the charging bucket is placed on a weighing machine, which is moved by electric traction to any one of a long row of bins. Here the charge is made up, weighed on the scale, whence it is moved back to the foundry building where the bucket is transferred to an elevator and raised to the charging floor. Here the monorail crane picks it up preparatory to charging the cupola. The scale car was furnished by the J. C. Busch Company, Milwaukee, and the elevator by the F. Rosenberg Elevator Company, Milwaukee.

The same siding which serves the storage yard is used for unloading cars of coke, sand and clay. The material is passed by chute from the cars into two continuous bucket elevators placed at one end of the building, one elevator handling coke and the other sand and clay. From the conveyors the material is dropped on continuous horizontal belts which discharge into storage bins. The coke bins are on the same floor as the charging room, while the sand, clay and like material bins are below. The conveying equipment was furnished by the Chain Belt Company, Milwaukee.

The new foundry of the Rundle Company is particularly noteworthy by the use of a sand throwing machine, manufactured by Beardsley & Piper, Chicago. This device differs from the standard type of moulding machine in that it throws the moulding sand into the flask. Its use eliminates all hand labour involved in shovelling sand into the flask and also involves no jolting, consequently causing no vibration of the floor of the foundry during operation. It is manufactured in both stationary and mobile types. The stationary machine, now situated in the smaller of two foundry bays, will be transferred to the larger bay. A traction type of machine operates on a track in the smaller bay and a second track has been provided on which another machine will be installed. The mobile machine is operated by motor on the principle of the pinion and rack, the teeth of the supporting wheels of the machine engaging teeth in the rails. The path between the rails, a distance of 11 ft., is heaped with moulding sand, and as the machine progresses, a large screw, extending the width of the machine, carries the sand to a point midway in the track where a continuous bucket chain lifts it and discharges it into a screen on the moulding side of the apparatus. It is to be noted that the conveying screw consists of two distinct and opposing parts, having right hand threading on one side and left-hand threading on the other to insure the propulsion of the sand to the centre, where it is picked up by the bucket conveyor. A single 5-h.p. motor performs the traction and operates the screw and bucket hoist.

The screen into which the bucket chain drops the sand is oscillated by a 2-h.p. motor, the refuse being drawn off by a chute to a box below and the screened sand dropping into a hopper and thence to a continuous belt. The sand is discharged by the belt into a partially enclosed motor-driven paddle, which throws the sand at a high rate of speed into the cope or the drag below. The arm of the machine carrying the sand belt and paddle is pivoted on the arm supporting the screen oscillator. Hence the discharge spout of the machine can be moved to any position within a wide radius, the length of the adjustable arm being 11 ft. A 3-h.p. motor operates both the belt and the paddle. The control of the machine is on the spout, where the operator is at work. The drag and cope patterns and the bottom board are carried along by the machine on two trailing platforms, mounted on wheels.

At the conclusion of a day's moulding, when the machine has reached the end of the track, it is hoisted by overhead travelling crane and turned around so that it is ready to commence operations in the opposite direction on the coming morning.

Before the machine was used in the Rundle plant it took a moulder an average of 40 minutes to ram a bath tub mould. The sand thrower does the work in 6 minutes. No hand-ramming whatsoever is required with the new method, and because of the ability positively to control the force of the sand as thrown by the machine, the mould is uniformly hard throughout. This is distinctly advantageous, as it enables the company to cut down the weight of the tub. Weight, it should be noted, means nothing from a selling standpoint, as a heavier tub will bring no more than a lighter one if the dimensions are identical. At the same time, any saving in metal effected means a reduction in manufacturing and shipping costs.

RUSTY CAST-IRON SCRAP.—According to a recent issue of the "Fonderie Moderne," rusty cast-iron scrap loses much silicon on re-melting. Burnt iron, such as boiler grate bars always suffer a large loss in silicon; it has also usually picked up much sulphur. This can be neutralised by the addition of high-silicon pig and ferro-manganese, the latter for the purpose of forming sulphide of manganese, which is practically without effect on the carbon. The writer advocates that the enormous quantities of rusty scrap should be put on to the market in the form of pig which should have been put through some desulphurising process.

Treatment and Uses of Dolomite.*

Dolomite carefully selected with reference to its content of silica and alumina is converted into what is known as "shrunk dolomite" by a process of calcination at a high temperature in specially-constructed kilns. Shrunk dolomite is mainly employed as a basic lining to converters and for the hearth and banks of the open-hearth basic furnace.

Calcining.

On calcination, dolomite undergoes a progressive dissociation which may be considered chemically as covering two distinct stages. The first effect of rising temperature is the expulsion of carbon dioxide from the magnesium carbonate contained in the dolomite and the formation of a mixture of magnesium oxide and calcium carbonate, accompanied by a considerable reduction volume. During this stage, in all probability, a combination will be effected between the impurities of the dolomite, such as silica, alumina, etc., and an equivalent amount of magnesia, resulting in the formation of such compounds as magnesium orthosilicate (*forsterite*), magnesium aluminate (*spinel*), and magnesium aluminium silicate (*pyroxene*). The formation of any or all of such compounds will, of course, be dependent upon the relative amounts of silica and alumina present. Forsterite will form in those rocks in which silica is in excess of the alumina, while spinel is only possible in cases where the alumina is predominant.

Complete calcination results in the expulsion of the remaining carbon dioxide, a still further reduction in volume, and the production of a dense crystalline aggregate of magnesium and calcium oxides.

Microstructure.—Pure dolomite, when fully burnt, consists of a ground-mass of crystalline *lime*, throughout which are scattered very numerous, small, rounded grains of *periclase*. The structure is remarkably compact, and the only cavities present represent spaces that existed in the limestone used; the porosity occasioned by the loss of CO_2 has thus been almost completely eliminated by the crystal-growth of the oxides. Both constituents belong to the cubic system and pure burnt dolomite is, therefore, isotropic. Sections of ordinary commercial material nearly always show the presence of two common impurities, namely, excess lime and silica. Excess lime, if due to a general deficiency in the magnesia-content of the stone, is evidenced by a relative scarcity of the periclase granules, but if, as frequently happens, it is present as veins or crystals of calcite, these are converted into patches of pure lime, which has a coarsely crystalline structure with cubic cleavage. Silica, which is generally present to the extent of from 2 to 7 per cent., is indicated by weakly birefringent areas, that represent lath-shaped crystals of a silicate. This silicate is certainly very rich in lime, and a relatively small quantity of silica suffices to convert the whole of the free lime of the dolomite into silicate. Pieces of dolomite rich in silica occasionally pass through the kilns and have a glazed appearance after burning. A micro-section of such a piece will show that the free lime has been almost entirely replaced by an aggregate of elongated silicate crystals, while the periclase granules remain scattered throughout the mass. The presence of so much magnesia in the form of periclase must indicate that the silicate does not dissolve any considerable amount of magnesia. These siliceous fragments keep their shape well, and it would appear that the silicate is solid at kiln temperatures.

Artificial additions of silica are sometimes made with a view to protecting the dolomite from perishing, the object being to produce a glaze upon the surface; in this case the silicate of the glaze may be of a more acid character than that formed in the body of the dolomite. The ortho-silicate, if formed, causes disintegration owing to a sharp volume-change that occurs on cooling, and for this reason the use of silica seems to be inadvisable; some success has been obtained by the addition of iron oxide.†

Perished dolomite.—When burnt dolomite is exposed to the action of water, the free lime becomes converted into an aggregate of birefringent flakes of calcium hydroxide; these are sometimes seen in sections that have been ground with water. The mass falls to a powder and is useless for the furnace hearth. In the powder the periclase granules remain unaltered, they are but little soluble even in hydrochloric acid and may be separated by this means. Methods for the isolation of the magnesia have been proposed which depend on similar reactions to the above. On account of the porous texture of the perished dolomite it does not seem possible to restore the original compact structure by re-burning, though the expulsion of the water is easily brought about.

The lining of the dolomite kiln.—The kilns are lined with basic material rammed with tar and burnt in. The function of the tar is very obscure, but it is generally held to be essential for the close fritting of the basic material. Sections through the lining in a partly-burnt and in a completely-burnt condition show that the burning results in a continued growth of the grains of magnesia and of the interstitial line; the structure remains otherwise very similar to that of the burnt dolomite. It is observed by the manufacturer that fragments of siliceous rock are apt to form slag, and so adhere to the walls of the kiln; conversely, the kiln walls will require to be sufficiently low in silica to remain solid and dry at the furnace temperature.

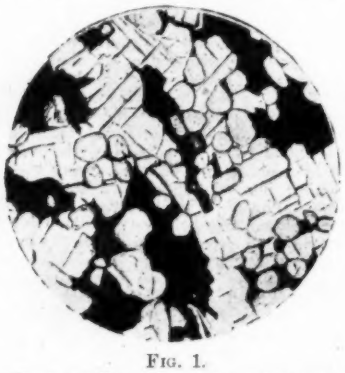

FIG. 1.

FIG. 1.—BANK OF BASIC FURNACE, ABOUT THREE INCHES BELOW THE SURFACE. GRANULAR YELLOW PERICLASE, CRYSTALLINE LIME SHOWING WELL-DEFINED CUBIC CLEAVAGE, AND A SILICATE DEEPLY STAINED WITH IRON. FROM A DRAWING × 100 DIAMS.

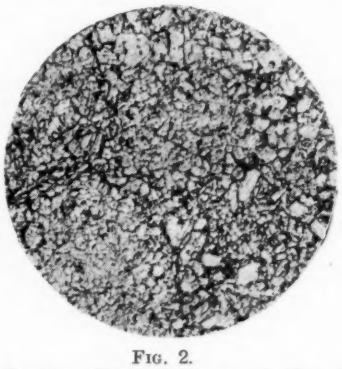

FIG. 2.

FIG. 2.—BANK OF BASIC FURNACE. A FINE-GRAINED AGGREGATE OF GRANULAR PERICLASE, LIME AND LIME SILICATES. × 20 DIAMS.

Use in Furnaces

In the basic process the banks of the furnace are exposed to the action of a highly basic lime-slag containing up to 50 per cent. of CaO. For this reason the banks must be composed of a highly basic refractory material, of which the constituents only melt at temperatures higher than those that prevail in the furnace; the most suitable material has been found to be burnt dolomite. The conditions in the basic furnace, both as regards temperature and gas, closely resemble those that obtain in the acid furnace, the temperature in both cases being approximately 1,650 deg. C.

A preliminary examination of the System CaO-MgO has been made in the Geophysical Laboratory at Washington, U.S.A. It has been shown that the melting points of all mixtures of magnesia and lime are very high, that no compounds between these oxides are formed, and that solid solution of one oxide in the other does not occur to any considerable extent. On the solidification of fused mixtures of the oxides lime and periclase crystallise side by side.

Lime forms colourless isotropic crystals with well-defined cubic cleavage and high refractive index (1.83). The melting point has been estimated to be about 2,570 deg. C., and the specific gravity 3.15.

* Extracted from Vol. XVI. of the Special Reports of the Mineral Resources of Great Britain.

† The effect of various additions on the keeping properties of dolomite has been discussed by G. Schurecht, *Journ. Am. Cer. Soc.*, vol. 2, 1919, p. 291.

Magnesia in the crystalline form of periclase builds colourless isotropic octahedral crystals or rounded grains with cubic cleavage, and has a refractive index of 1.734. It melts at a very high temperature and has a specific gravity of 3.674.

Structure of the basic hearth.—The basic hearth, while consisting essentially of the mixed oxides, contains also an appreciable quantity of silica, part of which may have been present in the dolomite used, while the remainder may be derived from slag that has penetrated or that has been purposely added in making the hearth. Considerable amounts of ferrous and ferric iron are also present.

The various constituents give rise to a number of crystalline compounds in addition to lime and periclase.

In Fig. 2 will be seen a micro-section that illustrates the structure and composition of a dolomite bank at a position near the "wash." It is a mosaic of various crystalline compounds, and in considering such a structure it must be borne in mind that the crystals of the chief component minerals have grown at temperatures far below their respective melting-points. For this to occur it is not even necessary for an interstitial melt to be present, for it has been shown by Shepherd, Rankin, and Wright that at ordinary atmospheric pressures, and in the dry state, crystals of calcium oixde coalesce and grow rapidly at 1,400 deg. C. The structure so obtained is granular, the size of the component grains increasing with the duration of the heating, and is comparable with that produced in rocks that have been subjected to a high degree of thermal metamorphism, but have not been melted. It will be seen that in Fig. 2 there are traces of a coarse aggregate structure, certain elongated crystals being arranged along lines so as to divide the field into several areas containing material of the usual fine rounded grain. The lines are composed of a silicate of lime; they probably follow the outline of the original dolomite-fragments, and it is possible that they represent an infilling of the interstices with a little basic slag. Details of the average structure are shown with higher magnification in Fig. 1, in which three of the following constituents are seen.

(1) Lime :—Large isotropic crystals show very perfect cubic cleavage. The outline is quite irregular, being in most places that imposed by the shape of the adjoining mineral grains. The size of the crystals indicates rapid grain-growth in the manner mentioned above.

(2) Magnesia :—Periclase. Small yellowish rounded grains are scattered throughout the section; several can be seen adjoining the large crystals of lime, and they are sometimes embedded in this constituent. Samples of the bank when kept in the open air fall to pieces owing to the slaking of the lime. The magnesia, however, does not at first undergo any alteration, and can be isolated by digesting the powder in moderately strong hot hydrochloric acid and removing the gelatinous silica by the addition of a little hydrofluoric acid. The residue forms a yellow powder which on qualitative analysis yielded chiefly magnesia. Manganese and ferrous iron were, however, present in noticeable amount. The refractive index was found to be somewhat higher than 1.76, a value distinctly above that for pure periclase. It seems likely therefore that these oxides are present in solid solution.

(3) Tricalcic silicate?—Elongated crystals seen arranged in lines in Fig. 2 are also found in other parts of the section, but do not occur in Fig. 1. When etched with hydrochloric acid their surfaces become covered with a film of gelatinous silica which may be stained easily with organic dyes.

The mineral is weakly birefringent and has a longitudinal cleavage, moderate refractive index and straight extinction. It appears to agree in general character with the tricalcic silicate, but further investigation will be required before its identity is definitely established.

(4) Magnesium silicate?—The fourth constituent occurs in numerous grains with moderate birefringence. The optical properties are obscured by iron-staining, which occurs to a variable extent, but frequently imparts a deep brown tint to this substance, as in Fig. 1. With hydrochloric acid it is readily decomposed and yields a thick film of gelatinous silica.

The sections described above were taken from the bank of a basic fixed furnace that had only been in operation for three weeks; they exhibit well the structure of a relatively pure dolomite bank at a distance of about 3 in. below the surface.

Stability of the basic hearth.—Lime, magnesia, and burnt dolomite are all perfectly infusible at the temperatures reached in the basic hearth; nevertheless, it would be impossible to form a satisfactory hearth by the use of lime in place of dolomite. Magnesite hearths have been used successfully, especially in America. The durability of the material seems to be closely connected with the marked resistance of magnesia to attack by calcium silicate; this property, so strongly evidenced in the preceding descriptions, probably extends to the action between the bank and the slag of the bath itself.

Besides the oxides, the silicates $3CaO.SiO_2$, $2CaO.SiO_2$ and $2MgO.SiO_2$ are solid at temperatures reached in the furnace, but their melting points are greatly lowered by the addition of impurities. In those parts of the hearth which are not directly in contact with the melt they will be largely in the solid state, and there is no special reason for the use of magnesite in preference to dolomite; at the surface the magnesite will be more resistant to the continued attack of silica in the slag. Fettling with a mixture somewhat richer in magnesia may therefore be advantageous, especially if the dolomite is rather rich in lime.

The Freeman Precision Temperature Control.

The British Oil & Fuel Conservation, Limited, 9, Southampton Street, Holborn, London, W.C.1, have recently introduced an apparatus described as the Freeman Precision Temperature Control, which automatically regulates the supply of gas in gas-fired furnaces, and assures an accurate maintenance of the pre-determined temperature. It does this by supplying the proper amount of gas required to maintain the desired temperature. This obviates excessive use of gas, loss of material through over-heating, and assures economy of operation and regularity of production. When the desired temperature, as shown by a temperature indicator, is attained in the apparatus the temperature of which is to be controlled, the apparatus is adjusted and variation of temperature then becomes impossible. The slightest tendency towards increase of temperature causes the control to automatically operate, diminishing the supply of gas. If there is a tendency to decrease of temperature, the control automatically increases the supply. In this manner the pre-determined temperature is maintained with a minimum quantity of gas. The factor of variation is within one degree, and the instrument is applicable to both low and high temperatures.

The accompanying illustration shows the air lead to the apparatus of which the temperature is to be controlled. This air lead terminates with an air bulb, which may be made of metal, glass, silica, carborundum, porcelain or carbon to suit requirements. The bulb is placed either within the material being treated,

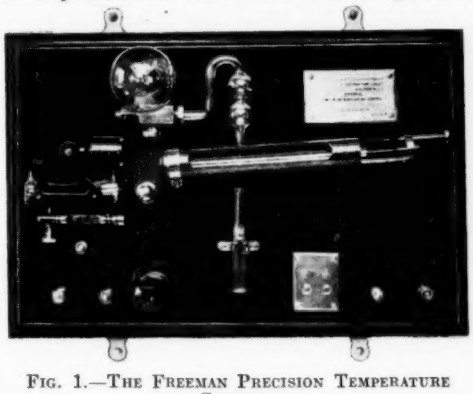

FIG. 1.—THE FREEMAN PRECISION TEMPERATURE CONTROL.

or within the apparatus which is being heated, in close proximity to the material being treated. The slightest change in temperature causes an expansion or contraction of the air within the bulb which operates a short column of mercury. This movement makes a contact with the adjustable electrical contact, which contact can be adjusted by a fine adjustment screw. In direct communication with the air duct which is operating the mercury column is a column of water. The glass tube dips below the surface of the water in the outside container, forming a water seal and also a means of conveying to the operator what is taking place within the furnace. The mercury column is mounted upon a trunnion, which admits of rotation so as to bring the mercury column into close proximity to the horizontal position, thus increasing the sensitiveness of the instrument. When gas is the medium for supplying heat a valve is placed in the duct, which is operated either by a compressed-air piston or a solenoid magnet. To operate these actuating devices, there is a nitrogen tube switch, which is operated by a horseshoe magnet. This magnet is excited when the mercury column makes contact with the terminal which ends in the fine adjustment screw.

XUM

High Tensile Steel Castings.*

By Federico Giolitti (Bessemer Medallist).

It is useful to illustrate the great variety of results obtainable on various types of steel castings by applying the processes which have previously been studied in theoretical outline,† especially in connection with the differences existing between the effects of homogeneity quenchings and of mere homogeneity annealings. In order not to multiply the examples unduly, some of the more typical instances will be chosen.

Normalised Mild Steel Castings.

A soft steel casting containing carbon 0.23 per cent., manganese 0.66 per cent., silicon 0.21 per cent., phosphorus 0.05 per cent., and sulphur 0.03 per cent., was reheated at 850 to 900 deg. C. and allowed to cool very slowly, requiring about 36 hours to reach room temperature.

The mechanical properties showed a maximum stress of 27.5 tons per sq. in., an elastic limit of 15.3 tons, and a 13 per cent. elongation.

The same steel reheated during twelve hours at 800 to 850 deg. C. and left to cool, requiring ten hours to reach atmospheric temperature, showed somewhat better physical properties, the maximum stress and elastic limit being 28.3 and 15.3 tons respectively, whilst the elongation was increased to 17 per cent.; the reduction in area was returned at 13.9 per cent.

Finally, another casting of the same steel—after undergoing the first treatment above mentioned—was reheated at 800 deg. C. during twenty minutes, quenched in boiling water, and finally soaked for one hour at 650 deg. C. Its properties are now still better, as the maximum stress has been raised to 32.8 tons, the elastic limit to 20.9 tons, the elongation to 17.5 per cent., and the reduction of area to 24.8 per cent.

Effect of Insufficient Annealing.

Another mild carbon-steel may be cited, made by the acid process and having the following composition:—

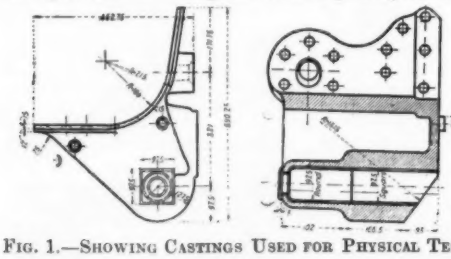

FIG. 1.—SHOWING CASTINGS USED FOR PHYSICAL TESTS.

Carbon, 0.25 per cent.; manganese, 0.85 per cent.; silicon, 0.15 per cent.; sulphur, 0.02 per cent.; phosphorus, 0.03 per cent.

It was cast in ingots 15¾-in. square. Rectangular bars 3½ x 5½ x 11¾ in. (80 x 150 x 300 mm.) were taken from the lower half of those ingots and subjected to the heat treatments indicated in the first column of Table I. In the next four columns of the same table are noted the principal tests on tensile pieces 13.8 mm. in diameter by 100 mm. long, taken from the bar after being subjected to the heat treatments indicated.

TABLE I.—*Tests on 0.25 Carbon Casting.*

Heat treatment.	Physical properties. Max. stress, tons per sq. in.	Elastic limit, tons per sq. in.	Elongation, per cent.	Reduction in area, per cent.
Annealed at 940° C. during 45 min. followed by slow cooling in the furnace ..	35.5	18.6	17.5	18
Annealed at 850° C. during 45 min. followed by slow cooling in the furnace ..	34.2	19.7	14.0	13
Heated and cooled as No. 1 followed by a soaking at 700° C. during one hour and subsequent slow cooling in the furnace	32.6	17.7	21.5	27
Heated and cooled as No. 2 followed by a soaking at 700° C. during one hour and subsequent slow cooling in the furnace ..	33.2	18.6	26.0	35

Table II. confirms that heat treatment has a very limited effect on very soft steel castings. The steel examined was of following composition:—Carbon, 0.09 per cent.; silicon, 0.028 per cent.: manganese, 4.47 per cent.; sulphur, 0.01 per cent.; phosphorus, 0.02 per cent.

TABLE II.—*Tests on 0.09 per Cent. Carbon Steel.*

Heat treatment.	Physical properties. Tensile strength tons per sq.in.	Elastic limit, tons per sq. in.	Elongation, per cent.	Reduction of area, per cent.
Heated at 850° C. for 3 hrs., followed immediately by quenching in water and then drawn at 650° for 2 hrs.	22.5	13.3	31.8	55.8
Heated for 14 hrs. at 1100° C. follwed immediately by quenching in water. Reheated at 850° C. for 3 hrs., followed immediately by quenching in water. Finally, soaked, at 650° C. for 2 hrs. ..	24.3	15.0	33.0	60.2

Ingotism.—When steel is cast in quite large masses, either in ingots or in formed castings, the phenomena of ingotism always appear with a great deal higher intensity than when it is cast in smaller sections. This is due to the slowness of cooling during the solidification range, which enhances the phenomena of intercrystalline liquation and segregation. Ingotism also shows a greater intensity when massive castings contain large quantities of inclusions. Evidently the steel then feels the effects of even a mild heat treatment a great deal more than it would were it cast in smaller masses.

As an example of this fact, take the case of an acid open-hearth steel having the following composition:—Carbon, 0.47 per cent.; manganese, 0.63 per cent.; silicon, 0.27 per cent.; sulphur, 0.029 per cent.; phosphorus, 0.03 per cent.

Rough castings weighing more than ten tons each for 381 mm. gun cradles were made with this steel. One of these castings was heated for twelve hours at 750 deg. C. Tensile test-piece (cylindrical rods 13.8 x 100 mm.) and Charpy impact samples (30 x 30 x 160 mm., with a semi-circular notch 4 mm. in diameter) were then cut from the body of this casting.

The results of the tests show that after being heated for 12 hours at 750 deg. C., the maximum stress was 34 tons per sq. in., with a 19 per cent. elongation. The Charpy sample gave 1.2 Kg.-M. per sq. cm. The same casting was reheated for seven hours at 850 deg. C. and then left to cool in the air, so that its temperature dropped to 400 deg. C. in about three hours. The effect of the heat treatment was to send up the maximum stress to 39 tons, the elongation to 24 per cent., and the Charpy test to 3.61.

These data well indicate the mechanical characteristics by which ingotism appearing in thick masses of cast steel exhibits itself, especially when the metal contains large quantities of emulsified inclusions. In fact, we must conclude that the "normal" properties of this steel are still altered or disguised even after the long heating at 750 deg. C. Were this not the case, there can be no doubt that the effect of the second heating at 850 deg. C., followed by slow cooling, should have changed the physical properties of steel in an opposite direction to those which in reality it has produced. The above examples confirm the idea that the average properties as usually determined on steel affected by ingotism are most probably due to the distribution and the continuity of the structural constituents rather than to the specific properties of the constituents themselves.

In order to ascertain the influence of carbon on the physical properties of steel castings, two samples, designated A and B, were prepared. The analysis of A was carbon 0.21 per cent., manganese 0.94, silicon 0.19, sulphur 0.03, phosphorus 0.07; whereas B contained 0.34 per cent. carbon, all the other elements were, within analytical error, the same as A, as cast A gave a maximum stress of 33.8 tons per sq. in., and B 38.7 tons, with proportionate elastic limits. The impact figure returned by the Charpy method was 4.62 Kg.-M. per sq. cm. in the case of A, and 1.7 in the case of B.

Both these samples were heated at 850 deg. C. for three hours and slowly cooled. This increased the tensile strength of the low-carbon steel A by almost a ton, but decreased the strength of B by some 10 cwts. The Charpy test, however, indicates that both samples have benefited by the treatment; 8 13 Kg.-M. per sq. cm. were withstood by A, and 6.15 by A.

A further heat treatment, consisting in heating the castings to 850 deg. C., quenching in air, and tempering at 550 deg. C., improved the castings in regard to all the usual physical tests. The results obtained from this treatment compare as regards the usual tensile tests very favourably with forged specimens. Speci-

* Extracted from a recent issue of the "Chemical and Metallurgical Engineering."

† "Heat Treatment of Soft and Medium Steels," Press of McGraw Hill Book Co.

mens 4-in. square were forged at 1,000 deg. C. to bars 1⅜ in. sq. On test, A gave 36 tons maximum stress in the forged condition, as against 35.5 tons after the heat treatment specified. Sample B, after heat treatment at 40 tons tensile, was actually half a ton higher than the forged specimen. The benefits derived from forging are better emphasised by the Charpy test, where 17.1 and 11.7 Kg.-M. per cm. were returned by the forged specimens, against 9.9 and 7.4 by the heat-treated samples.

The general fact may again be pointed out from the two examples that the differences between the effects produced by annealing and those produced by quenching are less remarkable the lower the carbon content, all other conditions being equal. For confirmation, compare the data contained in the tables and the corresponding half-tones.

Tests on Nickel-Steel Casting.—Nickel steel is more responsive to homogeneity heat treatments than carbon steels. Contrary to the experiments upon simple test pieces previously described, the present results were obtained by subjecting a casting of intricate form to various heat treatments. For this reason the following data will give the results which can be readily obtained in the practical application of heat treatments.

Steel used for these experiments was made in the acid open hearth and had the following composition:—Carbon, 0.26 per cent.; manganese, 0.90 per cent.; silicon, 0.18 per cent.; sulphur, 0.02 per cent.; phosphorus, 0.04 per cent.; nickel, 1.76 per cent.

Twenty-three pieces similar to that shown in Fig. 1. were cast from the same heat. Pieces for physical tests were taken from the thicker part of the wall of the partly-square, partly-cylindrical bore shown in section in the drawing. The whole casting had previously been subjected to a given heat treatment.

In order to have a base for comparison, a bar taken from an ingot of the same heat, after being forged and reheated at about 850 deg. C., gave 44.5 tons maximum stress and 17 per cent. elongation on 8-in.

Four distinct heat treatments were given to the nickel-steel castings:—(1) Heated for four hours at 800 deg. C., and cooled to room temperature in one hour; (2) similar treatment to (1), but the samples were reheated to 700 deg. C., soaked for one hour, and cooled over six hours to room temperature; (3) heated for four hours at 800 deg. C., followed by a slow cooling in the furnace requiring 18 hours; (4) a similar treatment to (3), but they had the additional treatment of reheating to 700 deg. C. for one hour and cooling over six hours. Treatment No. 1 resulted in a tensile strength of 42.4 tons, associated with a 15 per cent. elongation (on 2-in.), 14 per cent. reduction on area, and a 5.1 resilence (Charpy) figure. No. 2 returned a maximum stress of 38.7, a 21 per cent. elongation, a 22 per cent. reduction of area, and a 7.5 Charpy figure. After No. 3 treatment, the maximum stress was 41.1, the elongation and the reduction of area had risen to 28.5 per cent. and 39.8 per cent. respectively.

The Charpy test is also better at 8.22 Kg.-M. per sq. cm. No. 4 treatment slightly reduced the maximum stress to 40.9 tons, but had increased both the elongation and reduction of area to 33 per cent. and 52.8 per cent. respectively. The elastic limits in these tests were fairly constant at 24 tons per sq. in.

THE INFLUENCE OF NITROGEN ON CASE-HARDENED STEEL.—Messrs. Knight and Northrup, writing in a recent issue of the "Chemical and Metallurgical Engineering," state that cyanogen compounds used for case-hardening give more brittle cases than compounds which do not contain cyanogen and that this brittleness is due to nitrogen. This was suggested earlier by Le Chatelier, and Braune reports needles simlar to "nitrogen needles" in "Revue de Metallurgie," 1905, in his report on baths containing cyanide and ferrocyanide of potassium.

BRITISH INDUSTRIES FAIR, FEBRUARY 21st TO MARCH 4th, 1921.—Thanks to the enterprise of the "Mercantile Guardian," buyers who are coming to the Castle Bromwich section of this Fair will be able to save time by making the journey between London and Birmingham by aeroplane. An arrangement has been made with Messrs. S. Instone & Company, Limited, for service during the period of the Fair—the aeroplane used will be the famous "Vimy" Rolls-Royce twin-engine limousine type de luxe, similar to the machine that flew the Atlantic. The seating capacity is for 15 passengers, and the journey will take under an hour. The pilot will be one of those who was engaged on the London and Paris Peace Conference Air Mail Service. Full particulars can be obtained from the General Manager, British Industries Fair, 95, New Street, Birmingham.

A Crucible Skimming Arrangement.

A useful innovation to obviate the necessity for skimming metals during teeming has been made by the J. Dixon Crucible Company. In consists in attaching to the under side of a sheet-iron crucible lid a graphite bridge, which mechanically effects the necessary skimming, as shown in the illustration. The use of such an apparatus tends

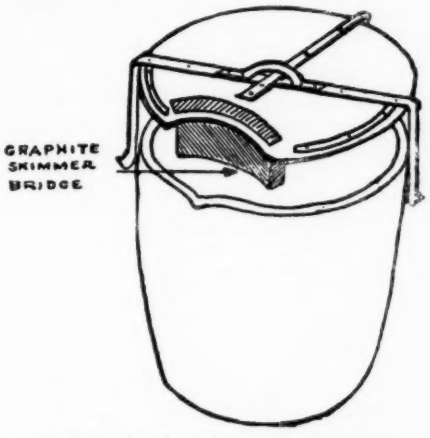

FIG. 1.—AN AUTO-SKIMMING CRUCIBLE.

to eliminate such noxious fumes as zinc smoke. Naturally, the services of one man, normally employed in keeping back slag or dross with a skimmer, can be dispensed with. The European business of the J. Dixon Crucible Company is handled by Mr. C. R. Averill, of 28, Victoria Street, London, S.W.1.

Concrete Pipes.

In the course of a Paper on this subject, read in Birmingham before the Midland Junior Gas Association, MR. L. H. THOMAS remarked that about four years ago the Barnsley Smokeless Fuel Company used concrete gas mains of 14 in. and 24 in. diameter. The 24-in. pipes were 2 in. thick, and the 14-in. were 1¾ in. thick; the cost was very much less than that of cast-iron mains. The joints were made with tarred tow between the pipes, and a cement collar was formed round the joints. These have been quite satisfactory, but the best reinforced concrete pipe made is the Hume, the manufacturing rights for which, in this country, the Stanton Company have acquired. This pipe is made centrifugally, and the resulting concrete is very dense and hard. Pipes thus made will withstand a pressure of 400 lbs. per sq. in. without weeping. As a test a mixture of petrol and paraffin was run into a pipe with blanked ends and put under a pressure of 200 lbs. per sq. in., and at the end of three months there was no sign of weeping.

It is estimated that in this country these pipes will be cheaper than cast-iron or steel pipes. They can be made in 12-ft. lengths, and are much lighter than cast-iron pipes. Specials cannot be made centrifugally, and it is the centrifugal action which makes the pipes so dense, so that specials are still being made in cast iron with all spigot ends and jointed with the reinforced concrete collar.

The Hume pipe has been used now for several years in South Africa and Australia, and has fulfilled the most sanguine hopes of the inventor. Considerable progress has also been made with the Hume pipe in India.

The Hume pipe was first made in South Africa, and the method adopted is to revolve a steel cylinder at the rate of 250 to 300 r.p.m. The concrete is then thrown in, and the centrifugal force thus produced gets rid of the water and forces the concrete against the sides. Three 12-in. pipes can be turned out in seven minutes.

The fact that the Stanton Coal & Iron Company, who are so largely concerned in the manufacture of iron pipes, should have obtained the rights in a process for making reinforced concrete pipes is a matter of significance, and it appears increasingly probable that these pipes will become popular in this country and gradually oust cast-iron pipes.

XUM

"Safety First" in Steelworks.

By H. S. Burn.

It is said that ultimate success in ensuring safety to parts constructed of steel is dependent upon the sympathetic collaboration of the engineer and the metallurgist.

It may be said with equal truth that ultimate success in ensuring the safety of life and limb of those employed in any undertaking is dependent upon the sympathetic collaboration of the management and the workers.

We shall endeavour to show that, given this sympathetic collaboration, the improvements to be looked for in a "Safety First" campaign are not difficult to realise, nor is the campaign anything more than a simple straightforward proposition.

In order to make clear the varied character of the works dealt with (Messrs. Thos. Firth and Sons, Limited, Sheffield), it should be noted that they cover an area of between 40 and 50 acres, and include what are, in some cases, isolated works at a distance of two miles from the main offices.

The trades carried on also entail great variety of types of machinery and plant, as will be seen from the following list.

The works comprise the following sections:—Open-hearth steel furnaces, crucible furnaces, electric steel furnaces, steel foundry and pattern shop, heavy press shop and forges, rolling mills, light forges, file making, twist drill making, heavy machine shops on marine work and shafting, and various other manufactures such as saws, railway couplings, etc.

By the time that the usual complement of construction and maintenance trades such as joiners and bricklayers, etc., are added, it will be seen that the field is very wide, the number of employees being now approximately 4,000.

It was realised from the beginning that the display of posters at the entrances to works would not be sufficient, and schemes were prepared for forming committees to further the objects of the campaign. In September, 1919, a definite scheme was approved, and it was decided to form two committees of workmen, one committee for a more distant portion of the works employing about 1,400 hands, and the other committee of the remaining group of works, employing about 2,600.

In order to introduce the scheme to both the workers and the works staff, a preliminary meeting was held at each of the works, and to each were invited the managers and certain of the foremen, together with about six workmen from each trade or section of the works, such, for instance, as rolling mills, machine shops, etc., making altogether a meeting of about 60 persons.

The following scheme* was then explained:—

1. That each committee should consist of eight representatives drawn from the various sections, such as Siemens furnaces, rolling mills, forges, steel warehouses, crucible furnaces, etc., together with a permanent secretary who would be supplied by the firm.
2. The committee, when constituted, to elect their own chairman.
3. The committee to meet, to commence with, twice a month, and at the end of four months a ballot to be taken as to the order in which members were to retire, such members not being eligible for re-election for a minimum interval of two years. After the first four months one member to retire from the committee each month.
4. The election of the committee to be carried out by the workmen in the various sections, and each elected member to nominate a permanent substitute for occasions when he could not be present, such a substitute to be a man preferably on the opposite shift.
5. In the case of a committee wishing to visit the site of an accident or a point of danger under discussion, such visit to be made in non-working hours unless special permission is obtained (and it may be here explained that as a rule there is no difficulty in obtaining permission to carry out such inspection during working hours).
6. The duties to be given to these committees are as follows:—
   (*a*) To make reports upon unsafe practices and conditions in and about the works.
   (*b*) To investigate all important accidents and to consider methods for the prevention of similar occurrences.
   (*c*) To bring forward any recommendation for the British Industrial "Safety First" Association's Gallant Conduct Award.
   (*d*) To spread the "Safety First" idea among the workers.
7. At every fourth meeting of each committee, or at any other meeting to which he is invited, the firm's engineer would be present to discuss suggestions put forward which have been difficult of solution or to assist in any business necessary.
8. The meetings to be held in working hours, and an allowance made of a half hour's pay on datal rates, or average tonnage wages, to each man attending.

These preliminary meetings were found useful for discussing the best time at which to arrange the meetings, the settlement of which was rendered difficult owing to some working on one shift, some on two shifts, and some on a three-shift system. The preliminary meetings were a success and promises were obtained at them that an election should be duly held in the various sections.

It will be noted that the foremen are not included as members of these committees, and the impression should not obtain that this was arranged without careful consideration, as it is realised on all hands that it is important to obtain the co-operation of the foremen. The difficulty, however, immediately arose as to how to discriminate which foreman should be selected without making the committee too large, and also the disadvantage arising from drawing the foremen away from their duties during working hours.

It also had in mind another consideration which has proved more or less correct, and that is, that if the workers were to meet entirely amongst themselves they would conduct their discussion, in all probability, with more freedom, and realise their special responsibility to a greater extent.

In this connection it should be pointed out that the only pitfall to be guarded against is that a small percentage of the suggestions put forward by the committees may appear to indicate lapses or omissions in work carried out by foremen. It is easy, however, to meet this difficulty, providing the reports of these committees are first submitted to an official who is prepared to use some tact in bringing the suggestions before those responsible.

It was found necessary, in a few cases at the commencement, to point out that it was quite possible for all points of danger to escape the foreman responsible, and that it was not intended as a slur on his work to have such matters pointed out.

It will also be observed that members of the committees retire in regular order after serving eight months, and are not eligible for re-election until an interval of two years has elapsed; the advantage of this arrangement is that it ensures as many men as possible being brought directly into contact with the "Safety First" idea, and helps to advertise its advantages amongst all the workers.

The method of election was left entirely to the workmen, and in some sections a show of hands during the meal hour was decided upon. In other cases balloting was adopted, and the Secretary provided ballot papers and boxes, and if requested assisted at counting. The ballot has since become the standard method for all subsequent elections.

A chairman was elected at the first meeting to hold office until he retired.

Suggestion Boxes have been placed in the various Departments, and special forms can be obtained at all the Time Offices; these are headed as follows:—

State on this side the danger you wish to call attention to:—	*Suggest a remedy if you can. If not, leave to Committee.*
No	Dept.
Name	Date

The key of the box is kept by the representative of the section, and the contents are brought by him to the meeting, at which they are carefully considered.

If approved, they are recommended to the management for adoption. Every suggestion is acknowledged by the Secretary on the day after the meeting, and if it has not been recommended for adoption, the reason why is stated. This is much appreciated by the workers.

Up to the present time there have been 38 Committee Meetings, with a total of 176 suggestions, giving

* Extracted from the Report of the Proceedings of the Industrial Safety Council.

an average of four or five per meeting. Out of this total number not more than half a dozen suggestions have been found impracticable or unnecessary.

It may be asked what sort of suggestions do the Committees make, and, although there are hardly two suggestions on the same lines, the author thinks it may be of interest to give a few of the more typical ones :—(*a*) Guards missing or broken on main line belts or around machines; (*b*) Holes or broken floor plates on the floors of the shops or yards; (*c*) Lights required in the works yards; (*d*) Extra floor-space required at the side of railway wagons inside the shops; (*e*) Ladders for approach to crane tracks; (*f*) Roof glass broken and in danger of falling; (*g*) Hand-rails on travelling cranes; (*h*) Wall of shop bulging; (*i*) Danger from electric wires.

It should be understood that new safety devices are not to be looked for as figuring in many of the suggestions put forward, the reason for this being that care has always been taken by the firm to fix safeguards in accordance with modern practice, the main trouble in the past being that such safeguards were often disregarded, and fell into disuse.

The chief aim of the Committee is to bring to light repairs to guards and other points which might have been overlooked until an accident had occurred, and to impress at all times upon other workers that carelessness is the cause of accidents in probably 90 per cent. of the cases.

Every month a summary of accidents all over the works is supplied to the Committees showing the nature of the accidents. Out of 482 cases reported for the month of May not one was due to the absence of a safety device. Individual care would have avoided most of them.

The majority of firms should not find it necessary to appoint a special Safety Engineer, and the duties of Secretary to the Committees can well be combined with any other work, the chief consideration being to provide a suitable man.

This arrangement has the advantage that all suggestions are submitted to the man who knows intimately the whole of the plant and buildings in the works, and it is the author's endeavour to deal immediately with the suggestions when received, as the success of the working of these Committees is greatly dependent upon having the work carried out within a reasonable period.

It is beginning to be felt, however, by the author that, in order to maintain the interest in the "Safety First" campaign and to reduce still further the number of accidents, further efforts still are required, and it should be possible to devise some competition which will appeal to the various departments in a large works on the lines of the "Dodge" system in America. The only possible disadvantage that suggests itself is that this may tend to reduce the number of cases reported to the Ambulance Rooms in order to attain a higher place in the competition, and thus defeat its own object; but it is very questionable whether in practice this difficulty would attain any great importance.

It has been found that with the inception of the "Safety First" campaign the number of minor injuries attended at the Ambulance Rooms immediately increased, this being due to the stress laid on the importance of attending to all scratches. At the same time, however, the number of more serious cases showed a diminution.

It may be pointed out that the cost of the campaign is small, and most of the work ought to be carried out in any case.

In conclusion, the author desires to lay special stress on the importance of the heads of the firms taking interest in and giving a backing to the efforts being made with regard to "Safety First" campaigns in their works. Failure is likely to await the campaign if the interest taken in it is left to those in more or less subordinate positions.

Oil-Fired Annealing Furnace.

For several years the Atlas Steel Casting Company, Buffalo, N.Y., has been steadily endeavouring to improve the condition of its product by systematic advance in its methods of annealing. The situation and design of its plant make fuel oil its main heating factor.

The illustration shows the type of furnace which was finally decided upon. A main chamber, 15 ft. square inside and 5 ft. deep, projects above the floor level about 2 ft., making it convenient to charge and observe. Across one end of the main furnace lies the combustion chamber, about 4 ft. wide. Opening between these two chambers are four large arched ports. On the opposite side of the main furnace from the combustion chamber are the outgoing ports, which enter a common flue leading to the stack.

At one end of the combustion chamber is the firing-pit, containing three burners and the blast pipe, which latter is controlled by a handy windgate. Atomising is done by compressed air. In the outgoing flue a large air regenerator is installed.

The roof consists of three large bungs, approximately 5 ft. wide, made up of a cast-steel frame lined with firebrick. They are so designed as to be readily removed and stacked upon each other without disturbing the lining. In the wall of the annealing chamber, and also of the combustion chamber, are located thermo-couples. These are connected with a recording instrument in the office, and also with an indicating instrument near the furnace for use of the operator.

Practice with this furnace has shown that the charge can be brought up to the required temperature in a very evenly increasing heat, taking between nine and ten hours of steady firing. The furnace holds a charge of about 25 tons, varying somewhat with the size and nature of the castings. One of the hardest things to impress upon the average operator is that annealing is *per se* a slow process. Hard firing not only causes the combustion chamber to deteriorate rapidly, but almost invariably manifests itself by a heavy scale on the product, which in turn is indicative of a change in the structure of the steel.

The proper maximum temperature for the castings is 900 deg. Cent., but not to exceed 925 deg. The couple may indicate this temperature upon the chart, but that is the temperature of the gases in the chamber and the operator must judge by the condition of the charge when that degree of temperature has been recorded, whether each piece has been thoroughly and evenly penetrated to this degree. If large "chunky" pieces are in the charge, the furnace must be held at the maximum temperature, without increasing the heat, until the heavier sections are equally penetrated. Success in this lies in the judgment and eye of the operator, for the instruments only record exteriors. In addition to the recording pyrometer used with this furnace, the Atlas Steel Casting Company uses a Féry portable radiation pyrometer to check the readings of the recording instrument, to take the temperature of the metal itself (with all blast and oil shut off) and to take the temperature of the combustion chamber. As a rule, the difference in temperature between the two chambers is from 315 to 370 deg. Cent. at the maximum. Of course, the difference is much greater in the early stages of the heat.

FIG. 1.—AN OIL FIRED ANNEALING FURNACE.

By thus carefully following the progress of each heat, it was seldom that a "red" casting was found in the annealed charge, and when one was found it invariably proved to be the case that this condition was due to improper location in the furnace. Loading the charge is a very important operation and is now given much attention. With a large variety of castings in the charge, a haphazard loading will not result in an evenly annealed heat.

When the temperature is approaching the maximum of the recording chart, the actual temperature of the steel is easily taken with the radiation pyrometer, during which reading the feeds are shut down. After the operator judges the metal to be thoroughly permeated at about 900 deg. Cent.—usually after about nine and a-half hours—the fuel and blast are shut off, the damper opened, and the charge allowed to cool gradually for five or six hours.—"Iron Age."

Open Frames and Closed Plates for Pattern Making.

By E. J. Drinkwater.

Young journeymen pattern-makers often find difficulty in deciding whether to use plates or frames in constructing work, especially when they first enter a new shop. It is one of those important points of detail on which there is no recognised rule. In some cases the shop practice is not to differentiate between different jobs or to take into consideration whether the work is standard or otherwise, whether it is large or small, or whether the shape lends itself better to one form of construction or another, but to make frames, or it may be solid plates, for all classes and sizes of work. The system of adhering rigidly to a principle of construction without taking into consideration its applicability to the job in hand is common.

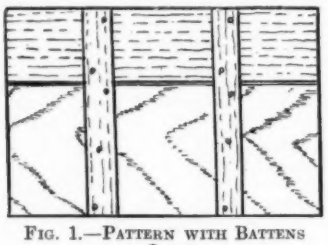

FIG. 1.—PATTERN WITH BATTENS INSET.

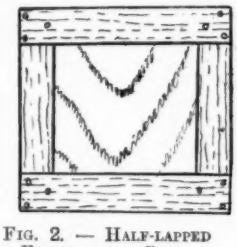

FIG. 2. — HALF-LAPPED FRAME WITH CENTRE-PIECE RESTING ON CHOCKS.

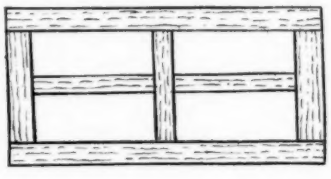

FIG. 3.—HALF-LAPPED FRAME WITH CENTRE RAILS.

Broadly speaking, all work that is less than 12 in square or 12 in. in diameter should be closed in. There are exceptions, of course, as when a pattern is leaving its own core, but there are exceptions to every rule in workshop practice which can be left to the judgment of the craftsman. When work which is boxed up is screwed or nailed it is not necessary to take precautions against it warping, but when the plate is the foundation on which ribs and bosses are to be screwed it is important that it should be well secured against warping or splitting. For coreboxes, battens may be screwed on the face, but not so with patterns, except in rare cases with rough work, when the batten space can afterwards be filled in. There are two methods to choose from, which are shown in Figs. 1 and 2. In Fig. 1 battens, preferably of hard wood, are inset to half the thickness of the board, their width depending on the size of the work, but generally they should be from 2½ in. to 3 in. wide. In Fig. 2 taken to leave the centre rails an easy fit, so that if they swell they will not twist the rails.

Some pattern-makers, when making half-lapped frames, plane up the timber to 1-16-in. thicker than the finished size, then, after the frame is screwed together they surface one face with winding strips, then gauge the thickness, and with jack- and trying-planes finish the other side. This method involves a great waste of labour. Whether there is a planing machine in the shop or not, the timber should be planed to just over the finished thickness, and if care is taken when cutting the half-laps very little surfacing will be necessary afterwards. It is advisable in case the frame is a little out of square to allow for planing ⅛-in along the edges. This does not mean that planing must be done, as if two edges are planed square the other two can be trimmed at a sharp circular or bandsaw. If the circular saw is sharp—providing there is not a half-lapping machine or wood miller—very little planing of the half-laps should be necessary.

When making circular plates a half-lapped frame is often possible, care being taken that the width at A, Fig. 4, is sufficient to give a full-sized lap, which is the difficulty with circular work. It is generally better either to make a plate similar to the one shown at Fig. 1, or in the case of big work to build with segments in two courses, and in order to get a centre line to insert a centre rail (Fig. 5).

There is another method of making big flat plates, which is shown in Fig. 6. It is handy for awkward shapes, but from a constructional point of view it is not nearly as good as the methods already described. It is obviously difficult to make a good half-lapped

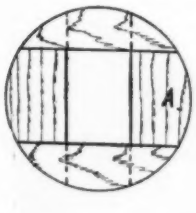

FIG. 4. — HALF-LAPPED CIRCULAR FRAME.

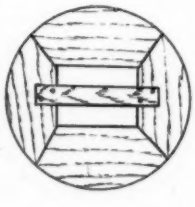

FIG. 5. — TWO-COURSE CIRCULAR FRAME WITH CENTRE RAIL.

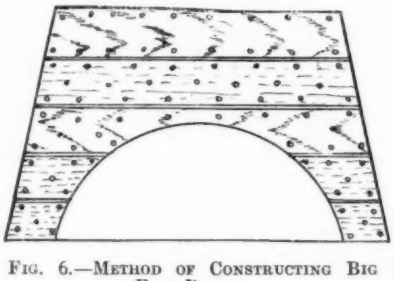

FIG. 6.—METHOD OF CONSTRUCTING BIG FLAT PLATES.

FIG. 7. — END VIEW OF A CIRCULAR FRAME.

another good method is shown, which is even better than the foregoing, and in a pattern-shop that is well equipped with machinery it is as easily done. A half-lapped frame is first made, and on the inside of the rails chocks are sawn so that a centre-piece can be cut to fit and dropped into position. A frame made in this way will not shrink as a plate made as in Fig. 1. If the frame is very thin, indeed, too thin for screws, wood pegs should be inserted. On very thin frames the writer has used lead rivets advantageously.

For large work of regular shape the half-lapped frame is undoubtedly best, and special cases excepted, it need not be filled in. The number of rails, of course, depends on the size of the work, but it is a safe rule, not to let the spaces exceed 12 in. square. The only cases when big frames should be filled in, are where there is a big number of ribs and bosses to be screwed on the face, as the moulder can easily strike out the sand between the rails. If the plate is on the top of the mould, however, it should be filled in in the same way as the small frame already described. Fig. 3 shows a large half-lapped frame. It is convenient to have centre rails, because it is then possible to draw centre lines on the work. Care should be frame for such an awkward shape, but the difficulty may be got over by making a plate in two thicknesses, for example, if the required thickness is 1 in., then ½-in. boards would be tacked on a building board side by side and on top of these, with the grain at right angles to the grain of the bottom layer, other ½-in. boards would be screwed. The shape could then be drawn and the plate cut. It is very important with such a plate that open joints should be left.

Fig. 7 is an end view of a circular frame, a form which is not unusual in many shops. To the inexperienced it presents difficulty, but it is really as easily made as a flat-frame. The circled rails have to be built of two or three thicknesses of segments screwed together. Care must be exercised in both drawing and finishing the rails, otherwise when the frame is built it will be badly twisted.

There are many other forms of plates which cannot be treated in a short article, and in the construction of which the pattern-maker must use his own judgment. The aim should be to get a firm, substantial plate, and especially so if it is the base of a job, because a good pattern cannot be constructed on a bad base plate.

Institution of British Foundrymen.

LANCASHIRE BRANCH.

Proposed Branch at Burnley.

With the object of bringing before those engaged in the foundry trades in North-East Lancashire the aims and advantages of the Institution of British Foundrymen, a meeting was held on Saturday, January 29, in the Technical College, Ormerod Road, Burnley. Mr. R. W. Kenyon, of Accrington, presided. An address was delivered by MR. W. H. SHERBURN, of Warrington, upon "The Foundryman: His Status in Industrial Life, and How It Is Being Improved."

The Chairman, in opening the proceedings, said foundrymen had been in the background with regard to education, and the Institution was established to remedy that state of affairs. It was hoped that a result of the meeting would be the opening of a Branch for Burnley and district. The hon. secretary of the Lancashire Branch, Mr. J. Hogg, was resident in the district.

The Foundryman: His Status in Industrial Life.

Mr. W. H. Sherburn said the word "foundryman," as defined by the Institution of British Foundrymen, included all who took a definite share in the production of castings in metal. The conductor of a foundry business (whether private employer or managing director), the designer, the chemist, the pattern maker, the moulder, and the furnaceman all came within the definition. The ideal foundryman was one who took a keen interest in and tried to understand every process which went to the production of good castings. The proportion of such had increased considerably since the formation of the Institution, and in order that the increase might be the more rapid propaganda work was being carried on.

Many foundrymen, particularly journeymen moulders, went through life with a grievance. They felt confident that they were as able and as good workers as those in other industries, and that their craft required as much intelligence as any other, yet they found that it was generally regarded as inferior to other branches of the manufacturing establishment. It was small wonder that seeing they did not command the respect to which craftsmanship entitled them, some of them ceased to respect themselves and began to think meanly of their craft. But the wise foundryman who knew its importance, that it was the foundation of the success of many other crafts, resented the low estimation in which it was held, and was ready to join any movement which would help to remove the stigma.

There were several reasons why this undesirable situation had come about. One was inefficient accommodation and equipment. Passable castings could be made in a shed with a few loads of sand, a furnace, a few ladles, boxes, and shovels. Too often this had been taken as the starting point, and as extensions became necessary the same undesirable unit was multiplied. Thus, there grew up the idea that any place was good enough for a foundry. Many such foundries still disfigured the industry. This equipment, or lack of it, resulted as might be expected, and many moulders acquired such an experience of the use of makeshifts and the rigging up of tackle, that little more was needed to qualify them as jobbing joiners or general handy tradesmen. This also laid them open to the reproach of not being methodical, scientific, and of being rule-of-thumb workers. They knew nothing of the chemical laws pertaining to the materials and processes they handled, although they were far from ignorant of the practical science underlying their work.

A second reason was the discomforts attending the work. The work of the moulder was necessarily dirty; it was laborious; and he was subjected to extremes of temperature—the heat of the casting operations and the cold winds that came through the open doors (or openings without doors).

From these conditions resulted a loss of self-respect and a feeling that they were unjustly treated. The fact that some discomforts were inseparable from their occupation made it imperative to reduce them to the minimum, and if this were done an improvement would take place in the outlook of the foundryman and in his bearing and behaviour. One cause of disaffection was that the modern developments of industry had widened the distance between the employer and the workman. In some way or other the workman should be made to feel that his employer took a real interest in him as a man, not merely as an employee.

The foundry was the basis of the success of all processes which rested upon castings. A faulty casting might be the cause of much wasted labour in other departments. But very few people realised how many factors contributed to the making of a perfect casting. There were a number of processes, apparently simple in themselves but actually complex, each of which had an important influence on the final result, and the neglect of one was sufficient to cause failure.

The pattern orginated with the designer, who did not always realise the importance of form and the relative weights and thicknesses of the various parts. Very seldom had the moulder any control of the design of a pattern, although he might see its defects when moulding and casting before he put it into the sand. Designing was becoming more and more important in view of the serious cost of materials and labour. In the past the supply of both had been plentiful and cheap, and British manufacturers were as prodigal with iron as with coal. This must cease. Lack of scientific knowledge of balance in castings led to the production of castings, portions of which were too heavy for the work they were required to do, and the excessive weight weakened the connection with the lighter parts, causing them to give way. A designer of castings should be familiar with the phenomena of crystallisation and shrinkage in cooling. In a well regulated foundry it should be an essential rule that when new forms of castings were being evolved the designer, the pattern-maker, and the moulder should be in close touch, and so much friction at a later stage would be avoided. When the pattern maker received the drawing he would find that, however well it had been thought out, there was scope for the exercise of his special knowledge and experience.

That there was a science underlying the making of a good mould all foundrymen would agree. When knowledge of that science was added to practical experience the moulder had greater confidence; he took a greater interest in his work, and at critical moments he kept his composure. He should strive to enrich his practical experience of the materials composing the mould by a complete knowledge of their nature and properties. Much remained to be done in that direction. The composition of moulding sand had not yet received exhaustive and systematic study, and it was high time that the mass of valuable experience existing in British foundries was collected, systematised and made available for the use of all. In this direction the Institution was doing good work. The idea of a central Bureau of Information on all foundry problems had been conceived, and no doubt it would materialise before long.

Of all the factors the metal was the most important. Probably more had been written and talked about it than about all the others put together. The foundryman did not always control the quality of metal supplied to him; it might not be suitable for the purpose on hand; but the castings were expected to be satisfactory for the purpose in view, in respect of soundness, malleability, uniformity, tenacity, softness, etc.

The fuel and melting conditions had an important influence on the metal. The method of gating, pouring, and cooling also had its share in contributing to success or failure.

There was a fascination about the work of a foundry of which the worker ought to be more conscious. To take the ugly unpliable lumps of iron, reduce them to a glowing stream, and shape that stream into innumerable articles of utility, was surely an act of creation. The fact that the processes were common, simple, and in some cases somewhat monotonous, should not take away the romance.

XUM

He hoped these points would have the effect of ennobling the craft in the estimation of foundrymen and convince them that it was worthy of the deepest study and research. Education in association was the readiest and most effective means of dispelling the haze which had accumulated in the atmosphere of the foundry, but there was much leeway to make up, and the co-operation of all concerned, both in direction and execution, was needed. About 20 years ago, as a result of some correspondence in a technical journal, a few foundrymen determined to form an association such as had been found so beneficial in other branches of industry. Thus, in quite a small way the British Foundrymen's Association came into being. Patiently it persevered, forming branches and holding annual conventions. At times the pioneers may feel a little disappointed that in some of the centres containing many foundrymen, the Branches did not grow more rapidly, but a sufficient number of foundrymen of all grades had seen the vision to ensure success. The power of association revealed itself in many ways. Scientific knowledge gained and exchanged was not the only benefit derived from the meetings. Employers, managers, foremen, and craftsmen met on common ground, and better acquaintance with one another awakened mutual respect and fellowship which had slumbered, and at times almost died, for lack of suitable opening. The British Foundrymen's Association grew until a change in name was advisable. It then adopted the title of the Institution of British Foundrymen. It came into line with institutions of a similar nature and assured its members of equal status. At the inception of the Association the foundryman was isolated, and foundries were scientifically in a state of chaos. To-day, Universities and Technical Colleges, with their professors and teachers, were in close touch with Branches of the Institution. The scientist realised what he owed to the experience and goodwill of the practical foundryman, while the latter saw that the scientist could help him to solve the problems which he met with daily in his work. The Institution gave both the opportunity they needed, and they were taking advantage of it more and more. He appealed to the employers and managers who had the supervision of foundries to give hearty support to the Institution on the grounds that it would encourage good craftsmanship and uphold the dignity of the worker. Let everyone determine that from this time he would do his part in raising the craft of the foundryman to its rightful place in the industrial life.

Mr. W. H. Meadowcroft (the President of the Lancashire Branch) moved a vote of thanks to Mr. Sherburn and to the Chairman. He gave testimony to the great value of the Institution for the training of students for positions as foremen and managers in the foundry trade. He hoped that that day would prove to be a starting point in the formation of a second Lancashire Branch at Burnley.

Mr. R. H. Place, who seconded the vote of thanks, said he had been a member of the Institution for a number of years and was very proud of the fact.

Mr. J. Hogg said he would be very pleased to assist in the formation of a Branch at Burnley. They were appealing for members, but it was not an easy matter to become a fully qualified member. If it were decided to start a Branch at Burnley they would have to apply for permission to the General Council, whose headquarters were at Bessemer House, London. Each member joining would have to be proposed and seconded by two members of the Institution; he would be passed by the Branch Council and afterwards by the General Council. No qualified foundryman would be refused admission, whether he was manager, foreman, or journeyman, if he showed himself sincere in his desire for membership.

At the meeting of the Lancashire Branch, held at Manchester on February 5, Mr. Hogg referred to the meeting at Burnley, which he said had been very successful. About 50 were present, and all the reports that he had seen or heard indicated that the address given by Mr. Sherburn was very favourably received. The principal of the College had promised that he would do all in his power to help if it was decided to establish a Branch in the district. It was so far from Manchester that attendance at the ordinary Branch meetings necessitated a great sacrifice of time and money. But he had been careful to point out that this was a matter for the General Council to deal with. They were indeed acting more strictly in the matter of applications for membership. That must necessarily be so now that the Institution was applying for a Charter. Everything indicated that the industry was rising to its proper place, and that they were on the high road to success.

HARD CASTINGS IN THE MACHINE SHOP.

A meeting of the Lancashire Branch was held on January 8 at the Manchester College of Technology, Mr. W. H. Meadowcroft in the chair. Mr. S. Hurst, of Radcliffe, read some notes on "Hard Castings in the Machine Shop." He said the firm he was engaged with had no foundry of their own, but had to depend on other people for their castings, and therefore he was able to cover a wider field than usual in his criticism of foundry practice, and give from an engineer's point of view the results of practical experience in regard to castings produced in the Manchester area. One of the chief difficulties in the machine shop was the hardness of the metal when subjected to machinery operations. This had been more evident during the past twelve months than at any previous time during his career as an engineer. It was a constant source of annoyance to have attention called to a blow-hole which had just been located in a big casting after the first cut had been taken over. It might happen after hours had been spent on the job, the operator repeatedly grinding his tool in order to get under the skin owing to the hardness of the metal. Sometimes one wondered whether the advance which was supposed to have been made in modern foundry practice was not more imaginary than real. Another real grievance was the difference in size and shape between the casting and the pattern. In one case his firm recalled an iron pattern, re-machined it, and made it as far as they could into a perfect pattern. They sent it back to the foundry people, and were much surprised when the next delivery of castings was made to find just the same irregularities of size and shape as previously. Very often these faults appeared to the engineer to be due to a lack of the manipulative skill which every self-respecting moulder's apprentice should try to possess—to incompetence or carelessness on the part of the moulder or core-maker. Investigation seemed to indicate that they were due to neglect of well-known technical precautions, some more obvious than others, but all such as should be well known and understood. They were due to ill-placed runners, feeders, gates and risers, insufficient venting, incorrect ramming and slovenly pouring. Some time ago his firm placed an order with a Belgian firm for the supply of castings, and up to now they had received about 40 tons. Those castings were a great improvement on what had been obtained locally; they were much cleaner and softer and easier to machine. In fact, he was able to machine them at a speed of between 70 and 80 feet per minute, an increase of 20 or 30 feet on the speed with English castings. This made a considerable difference in the cost of production, and was of vital importance to the economic running of an engineering business. Then where piecework systems were in operation hardness of metal led to considerable difficulties in connection with the piecework times which had to be extended, adding to the cost of production, and the overhead charges were also increased. Some defects in castings were caused through core points not being placed in the proper position. Sometimes they were eccentric with the body of the casting, and a greater number of cuts were required, necessitating extra machining. If a system of inspection could be introduced into the foundry such as prevailed in the machine shop it would have very beneficial results, and would be a check on the moulder in turning out careless and indifferent work. Some years ago he was with a firm who, because of the frequency of irregular and bad castings from their foundries, appointed him to inspect every casting as it came from the fettling shop, and to make a report of all which were rejected. This report was submitted to the

foundry foreman. The men concerned were asked for an explanation, and if carelessness or indifference was found stern measures were taken. Before very long there was a marked improvement in the castings. Co-operation between the foundry foreman and the machine shop foreman was very important. They should confer and keep in touch with each other as to any improvements which could be effected. Generally speaking, he urged upon the members who held responsible positions that they should keep in touch with those under them and be ready to render any help possible, such as giving practical demonstrations. Mutual assistance would give the best results.

DISCUSSION.

MR. JOHN HAIGH (Wakefield) said that during the past twelve months the foundry trade had passed through one of its bitterest experiences. In the beginning of the year they were in the throes of the moulders' strike, from which they had not yet completely recovered, and which had left the men in a frame of mind which did not tend towards good workmanship. The detrimental effects of that strike had been felt by the castings trade generally. He could not say much of the jobbing trade in the Manchester district, which one speaker that afternoon had stated gave so much trouble and which compared so badly with the foreign product. But following the moulders' strike they had had much unsuitable material delivered to the foundries. The result was that certainly hard castings were produced. There had also been very great variations in the qualities of iron produced during the past two years, but they were now coming back to their own again, and would be able to insist upon specifications and deliveries to order. In regard to the coke trade, before the war there were first and second qualities coke. During the war second quality coke had disappeared, and all coke was sold as first quality. The effect of this deterioration reached its culminating point in the coal strike when blast-furnace coke was supplied for cupola use, for which it was eminently unsuitable, and a great deal of trouble arose in districts where it was used. They must, however, review the whole position. During the war a lot of grey ironfounders were turned on to semi-steel mixtures and mixtures of a harder nature for munition purposes. They were also subjected to production tests, and many of them realised for the first time that in order to get good tests they had to err on the harder side. Before the war No. 4 hard pig iron could be purchased at a reduced rate. Owing to the war requirements this quality was used as a special iron for shells, and even yet some makers were endeavouring to sell it as special iron at a higher price than was warranted. This indicated one reason for the existence of harder castings. There was no necessity for hard castings, though, of course, there could be no high standard test for soft iron. He was not sure that machine tool makers were doing the right thing in asking for a very soft casting. The speed at which a casting for a machine tool could be worked was not to be taken as an index as to whether that was the best kind of metal for that job or not, but he quite agreed that staffs of the fitting shop and the foundry constantly confer. He quite believed that the foundries could meet the requirements of the fitting and machine shops subject to certain conditions. The first of those conditions was workmanship. The workmen would have to come to a more reasonable frame of mind and follow instructions. Another essential was the condition of materials. They must be able to buy freely the iron that was wanted at a reasonable price, and in the jobbing trade, *i.e.*, the competitive trade, they would probably do better in some cases if they would pay proportionately more for their castings than they did before the war. In former times foundries had been ruled out of court which were willing to give good castings, because their prices were higher than those of people who made inferior qualities. The tendency in the Manchester district before the war was to get every ounce they could out of the iron founder. This branch of the iron founding industry in Manchester before the war was not worth troubling about, and a similar state of things was likely to occur when business again became normal. In this respect the machinists who bought castings were the chief offenders. He had seen patterns changed about from one foundry to another for a difference of less than a shilling per cwt., and under circumstances when the casting price was relatively unimportant compared with the cost of the finished article. The foundrymen of this country were the best in the world, and the technical knowledge of this country with regard to metal mixing had reached a far greater stage of efficiency than ever before.

A MEMBER referred to the silicon content of certain Scotch pig iron, and pointed out that on analysis it had been shown that some makes of pig iron which were stated to have 2.5 per cent. silicon had been proved to show as high a content as 5 per cent. He thought it was very advisable that all the iron worked should be submitted to an analytical test.

ANOTHER SPEAKER quite endorsed the statement respecting the high silicon content, and instanced cases of Yorkshire and Derbyshire iron in which instead of 2½ to 3 per cent. the result came out at over 4 per cent. This, in conjunction with bad coke, meant trouble for the foundryman.

MR. H. SHERBURN (Warrington) said that personally he was not in favour of dismissing the subject by blaming bad coke and bad iron, but rather of reviewing the entire position and ascertaining whether it was the common knowledge of the industry which was also at fault. There was no doubt that the difficulties with which they were all confronted were capable of solution. In the past the foundrymen had been too ready to take things for granted. He had used certain brands of iron and certain brands of coke, and they had served him well. Therefore he had adopted the policy of *laissez-faire*. The times were changing, and a more accurate and scientific procedure must be adopted. Although in his own practice he was not using any of the brands of iron they were accustomed to pre-war, simply because they were not obtainable at the prices they were prepared to give, yet he had not experienced any serious difficulty because he happened to know how the particular brands they used were working out in analysis. Another point he advocated was the use of a larger number of brands of iron of the same type. The foundry trade was the one trade which did not receive standard iron. Steel makers bought their iron according to analysis, but the blast furnace people produced a fair amount of irregular iron and the foundries got it. By using a number of brands the variations in quality could be averaged, and a more uniform result obtained. This was a point of special importance to anyone engaged in making light castings. The question of foundry coke was also a difficult one. There was no doubt of the serious depreciation in quality during the past few years.

Grumbling would not do any good. If we cannot get better quality we must make the best of our available supplies. It was, however, necessary to vary our methods to suit the materials at our command. Fairly good results could be obtained with present-day coke, though, of course, the old ratio of melting per ton could not be maintained. If they did not know something of the chemical contents and physical characteristics of the materials they employed in their industry, they could hardly expect good results, and it was up to them to get to know. He entirely disagreed with the policy of blaming anything and everybody but themselves.

MR. J. HOGG (Burnley) said he realised that, especially in light repetition work, it was necessary to have soft castings in the machine shop. There were quite a variety of causes which conduced to the state of affairs existing during the past year. No doubt the qualities of both the coke and the pig iron had had something to do with it. Blast furnaces had their troubles as well as the foundries, but the deliveries of good quality pig iron now appeared to be more regular. Personally, he had not been much inconvenienced during the past two years in regard to poor quality coke, as he was in the fortunate position of being near some beehive ovens.

A feeling of sympathy should exist between the machine shop foreman and the foundry foreman. He had recently seen some very beautiful soft-grade Belgian castings, and it was high time that

XUM

British foundrymen generally became aware of their existence and clearly realised the nature of the competition they had to meet. These Belgian castings had been made with English pig iron, and it might be wise to assume that some of that excellent material now coming into this country was really of German origin.

MR. A. L. KEY (Manchester), in seconding the vote of thanks, said that the principal point in using pig iron was to know how to control and correctly melt it. Material properly manipulated would give normally soft castings. For those who could not obtain analyses easily the best alternative was to provide themselves with a silicon control apparatus, or otherwise Keep's Contraction Test.

MR. HURST briefly replied to the discussion.

NEWCASTLE BRANCH.

Annual Dinner.

The annual dinner of the Newcastle and District Branch was held on Saturday, January 29, 1921, at the Collingwood Restaurant, Newcastle.

ENGINEER-COMMANDER HAWKES, replying to the toast of "H.M. Forces," proposed by Mr. Young, said the fleet had done well during the war so far as propelling machinery was concerned, due to the genius of Sir Charles Parsons.

MR. W. J. PAULIN proposed "The Prosperity of the North-East Coast," and said that in recent times we had been living in a state of false prosperity, and, however much they desired everyone to have as high a wage as possible, it must be borne in mind that wages should have a reasonable proportion to what the industry would bear. Returned soldiers must play an important part in future industry, and he hoped the Trade Unions would adopt a manlier attitude towards them. The present idea seemed to be that it was somebody else's job to find them the money to live upon, and that had to be altered. He hoped the leaders would prove themselves potent leaders, but one of the first things about a modern democratic institution seemed to be "Thou shalt not obey." There were dangers looming ahead, and the competition we had to face in the future would be more prominent and of a more subtle disposition altogether.

MR. SUMMERS HUNTER, C.B.E., in responding, said they should try and discover a little brightness where at the present time things looked dark and gloomy, and to endeavour to point to a glimpse of sunshine. Mr. Paulin had referred to some of the difficulties under which the industries of this district, and of the whole country, were at present struggling. Personally, he said, he was closely associated with the cancellation of contracts amounting to a total of something like 22 sets of engines for vessels. But, however black things may look, we have to try and find some brightness. The leading Trade Unionists at a recent congress indicated their programme, but no reference was made to the laws of supply and demand. It seemed to be a perpetual addition to the abnormal war conditions, which granted to many people a temporary prosperity. No mention was made of removing restrictions, reductions in wages, or cost of living. A good deal was said, however, about the prohibition of overtime and the possibility of less production. Industry cannot continue on these lines.

But there are some bright points about the position of the Trade Union leaders, and, happily, there are still some sound, commonsense men amongst them. Trade with Russia is impossible, because Bolshevism has destroyed Russian industry of all kinds. Their greatest industry, agriculture, has disappeared. The crofters have given up their land for the benefit of those around them, and the cultivation of that land is given up solely to their own needs. There is no possibility of a harvest for years to come. They cannot give credit except paper, which cannot be redeemed.

MR. ROBERT WALLIS, who proposed "Our Institution," said they were doing a valuable work in helping to solve some of the problems which confronted the industry to-day. The cause of the present unemployment was that the cost of the articles they produced had gone past the purchasing power of their money, and the question of doles and unemployment benefits was, in his opinion, destroying the thrift of the individual. Capital was the only insurance that the workman had that he would be paid his wages.

THE PRESIDENT (Mr. Riddell), in the course of a reply, said in the past ironfounders had been far too modest with regard to the part they played. The foundry was a most important part of the industry, without which the other branches could not exist at all. They only got wisdom out of experience; it was a false notion to think that they made men wise by "cramming." They were making education cheap, but unless they sent people out to do something for themselves, and gain by experience, they would never do any good for their country. The Institution was one of the finest aids to education. Book-learning was all very well in its way, but unless a man was educated it was only reinforced ignorance. The best preceptor they had was trouble. He was anxious to see the membership of their Institution very much increased, and it could be done if everyone tried to interest his fellow man in his work. They had done a great deal even with their small numbers, and they had a great deal to be thankful for to the people who had started that Institution. Employers were beginning to wake up, and they expected to get a better class of work, not only from the technical schools but from the members of their craft.

Mr. Mayer had in hand a scheme whereby he was going to present to the Newcastle and Scottish branches a gold and silver medal, and he urged them to form a class in Newcastle.

SCOTTISH BRANCH.

At a meeting of the Scottish Branch held at Glasgow on January 15, Mr. Fraser (Branch President) in the chair, a Paper on "The Microscope and the Foundry" was read by Mr. J. W. Donaldson, B.Sc.

The Microscope: Its Use and Application in the Foundry

(*Abstract.*)

The science of metallography, or the use of the microscope in the examination of metals, was practically unknown until about 25 years ago. Previous to that Dr. Sorby indicated in 1864 that the microscope might be used with advantage in metallurgy for the examination of metals in the same way as it was used in geology for the examination of rocks and minerals. Little work, however, was done until about 1890, when many well-known investigators entered the field of metallographic research. Progress has been rapid, and with that progress is associated many distinguished names—Arnold, Andrews, Desch, Ewing, Guilliver, Guillet, Martens, Osmond, Roberts Austin, Rosenhain, Sauver, and Stead, to mention only a few. To realise how important the use of the microscope is in metallurgical and foundry practice one must remember that the properties of metals and alloys which are of industrial importance depend not only on their composition but to a great extent on their structure.

The metallurgical microscope differs chiefly from other microscopes in the method of illuminating the specimen. With the ordinary microscope objects are examined by means of transmitted light—that is, by light proceeding from below the stage and passing through the object on its way to the eye.

Metals and alloys, being opaque bodies, have to be examined, however, by reflected light. This necessitates a certain modification in the construction of the microscope. A vertical illuminator of some sort has to be inserted between the eyepiece of the microscope and the objective. Vertical illumination may be produced by two methods. An opaque reflector may be used, consisting of a mirror covering a portion of the object and allowing the light returned by the object to pass through the uncovered portion to the eye, or a transparent reflector, generally a plain glass disc which reflects a portion of the incident light on to the object and allows a portion of the light returned by the object to reach the eye.

In the use of the objectives and eye-pieces the most satisfactory are obtained by using ordinary achromatic objectives and ordinary Huygenian eyepieces. The objectives should be corrected for uncovered objects, as lack of clearness and definition caused by light reflection is obtained by placing cover glasses over bright metallic surfaces.

Three objectives are usually used—32 mm., 16 mm., and 4 mm.—and are provided with short mounts. For low-power work, such as examination of fractures, a 48-mm. objective is extremely useful, and for very high-power work a 2-mm. oil immersion is most satisfactory. Two eye-pieces, of 1-in. and 2-in. focal length, give the necessary magnifications with the above objectives—magnifications ranging from 20 to 1,000.

The source of light required to illuminate opaque bodies must be fairly intense, especially for photographic purposes. Daylight and ordinary gas or oil lamp are unsuitable. For eye work the light from the ordinary gas mantle or electric lamp focussed through a bull's-eye condenser is suitable, but for photography a more powerful light is required. The light in general use for this purpose is that of an electric arc lamp, either hand or automatically fed, although during the last year or two it is being displaced by the tungsten point-o-lite lamp, which gives a much steadier light.

For micro-photographs a camera is connected to the eye-piece of the microscope by some light-tight device. The camera can either be used in a vertical or horizontal position according to the type of microscope being used. For examination a small piece of the metal or alloy is cut by means of a hack-saw. Such a piece should be sufficiently large for one to hold when polishing, yet not too large, otherwise an uneven surface is obtained on polishing. It should be representative of the piece of metal or taken from the vicinity of the failure which is being examined. A piece about ½ in. cube is a suitable size. Polishing can be mechanical or manual.

The piece is ground down on an emery wheel until an approximate smooth and level surface is obtained. It is then polished on various grades of emery paper, starting with the coarse and finishing with the finest. Finally it is finished by polishing on selvyt cloth which has been treated with fine rouge, diamantine, or other polishing powder.

The sample when finished should be highly polished, perfectly smooth, and free from even microscopic scratches. When the polished specimen is examined under the microscope the surface appears bright or dull according to the illumination, but in most cases no structure is visible. To reveal the structure the specimen requires to be etched by some re-agent or other.

On etching, various constituents are differently attacked. Some etch quickly and dissolve away, while others etch slowly and stand out in relief.

By this means different constituents are distinguished from one another. The structure on a grey iron consists of free ferrite grains with graphite flakes running through them, and the structure of a white iron would be cementite and pearlite.

A pig-iron which contains the carbon chiefly as graphite is called a grey-iron, while one where the carbon is combined is a white-iron. Most irons, however, contain both free and combined carbon, so that the structure consists chiefly of ferrite, pearlite, and graphite on the one hand where the carbon is mostly free, and pearlite with more or less free cementite where the carbon is mostly combined. In pig-irons containing a fair percentage of phosphorus another constituent, made up partly of the phosphorus, appears, and is known as the phosphide eutectic.

Turning now to the non-ferrous alloys, we are met with a variety of constituents and structures.

Unlike iron and steel alloys, these constituents are not denoted by individual names. Three general types of constituents are formed, namely, solid solutions, eutectics, and intermetallic compounds. Solid solutions are, as their name denotes, solutions of one metal in another in the solid state.

Just as salt is held in true solution in water, so can one solid metal hold another solid metal in a state of true solution. When two metals alloy, one or more solid solutions may be formed. When this occurs the different solid solutions are denoted by the Greek letters α. β. γ. etc. For instance, in the copper-zinc series of alloys or the brasses we have the alpha, beta, and gamma solid solutions of copper and zinc. Similarly in the copper-tin series or the bronzes we have the alpha, beta, and gamma solid solutions of copper and tin.

The micro-constituents known as eutectics are mechanical mixtures of two metals alloyed together. They have a definite melting-point, and under the microscope show a bended structure at high magnification similar in appearance to pearlite in steel.

Intermetallic compounds are constituents formed by two metals when alloyed together forming a definite compound similar to a chemical compound. Cementite or iron carbide is an intermetallic compound with the formula Fe_3C. Copper and tin form one having the formula Cu_3Sn. A copper and phosphorus compound has the formula Cu_3P, and a copper and antimony one, the formula $Sb\ Cu_2$ and so on.

Generally speaking, two metals forming a series of alloys may consist of solid solutions or of a solid solution and eutectics, or of eutectics and intermetallic compounds, or of solid solutions and intermetallic compounds, or of all three. Metals in their free state may also be present. Hence the structure may be very simple or very complicated.

There are two general ways in which the microscope may be used. In the first place it may be employed for testing purposes, and in the second place for the investigation of failures. Used in the testing department, it acts as a supplement to other methods of testing. All finished material requires to be examined in order to determine its fitness or unfitness for the purpose for which it is designed.

Chemical analysis and physical tests, such as tensile, transverse, hardness, and impact tests only indicate certain properties of the material. Other points are not revealed by those methods of testing, and would be passed by unnoticed, and perhaps be harmful when the material was put into use if not brought to light by the microscope.

A point in favour of microscopic testing or examination is the rapidity with which it can be carried out. The fact also that it can be carried out on pieces of material which would be too small to analyse or to examine by physical or mechanical means is also of value.

The second and perhaps the most important use of the microscope is in the examination of failures.

Microscopic examination of failures, however, should always be used in conjunction with chemical analysis and mechanical tests wherever possible.

FORTHCOMING MEETINGS.

Birmingham.—"Phosphorus in Iron and Steel," by F. Johnson, M.Sc. (Birmingham), on March 5.

Coventry.—"Carbon in Iron and Steel," by Prof. T. Turner, M.Sc. (Birmingham), on March 16.

East Midlands.—Presidential address, by H. H. Moore, at Loughborough, on March 19.

Lancashire.—"Some Experiences in Cupola Practice," by J. Pell, on March 5.

London.—"Heat-Treatment of Copper Alloys," by J. S. G. Primrose, on March 10.

Newcastle.—"Some Notes on Centrifugal Castings," by J. E. Hurst, on March 12.

Scottish.—Paper by A. McCance, D.Sc., on March 12.

Sheffield.—"Cupola Practice," by W. Rawlinson, on March 18.

ALUMINIUM LOSSES.—According to Mr. Robert J. Anderson, writing in a recent issue of "The Foundry," the average casting loss of five large American foundries was 9.4 per cent. In one foundry nearly 20 per cent. of the rejections when making motor crank cases were due to cracks. In another foundry the greatest loss was due to trouble arising from sand, whilst in a third "moved cores" was the largest cause of wasters.

FRENCH FOUNDRY SCHOOL.—The "Fonderie Moderne" announces the formation of a school for apprentices by M. Henri Gras, secretary of the Paris Copper and Brass Founders' Union. The building consists of shops for melting, moulding, and fettling, together with stores for sand, coke, etc. Lecture-rooms, canteen, baths and gymnasium are also included. The order of the course followed is:—Preparation of sand; moulding; core making; drying stores; melting and fettling.

XUM

Trade Talk.

THE INSTITUTION OF BRITISH FOUNDRYMEN will hold its annual conference this year in Manchester from July 13 to 15th inclusive.

A LOCAL association of the Institution of Civil Engineers has been inaugurated in Yorkshire under the new scheme recently adopted by the institution.

CLOSE upon 2,000 men and 1,000 women are on strike at practically all the nut and bolt works at Darlaston, consequent upon the proposed reduction in wages by the employers.

A MESSAGE from Santiago de Chile states: The Government has postponed the final date for sending in tenders for the electrification of the railways in consequence of several British firms desiring to compete for the work.

AT a meeting of the Scottish Centre of the Institution of Civil Engineers recently held in the rooms, 207, Bath Street, Glasgow, a paper on "Automatic Protective Devices for Alternating Current Systems" was read by Mr. A. E. M'Coll.

AT the ordinary meeting of the Institution of Electrical Engineers, which will be held at the Institution of Civil Engineers, Great George Street, Westminster, to-day (Thursday), at 6 p.m., Professor E. Wilson will lecture on "Magnetic Susceptibility of Low Order."

THE annual general meeting of the Institute of Metals will be held at the House of the Institution of Mechanical Engineers, Storey's Gate, Westminster, on Wednesday and Thursday, March 9 and 10, at 10.30 a.m. The annual dinner will be held on March 9.

SOME remarkable films taken at Steel, Peech & Tozer's Sheffield and Rotherham works, show every detail in the manufacture of their finest steel. The film follows the raw material from the moment it comes in at one gate until the finished product goes out at another.

OWING to the stoppage of shipping and the shortage of iron ore, the result of the Australian strikes, many employés of the Newcastle (New South Wales) steel works have already been dismissed, and it is expected that the works will be wholly shut down before long. Altogether some 10,000 men will be affected.

W. H. DORMAN & COMPANY, LIMITED, Stafford, will, at the Olympia Exhibition, have on exhibit a rock drill working on the new principles of wave transmission, and will be giving daily demonstrations of the same. It is the first time in the history of engineering that a demonstration of this character has been possible.

A SHEFFIELD branch of the Amalgamated Engineers' Union has unanimously passed the following resolution:—"That this branch of the Amalgamated Engineers' Union protests against the overcrowding of the Sheffield schools, and affirms that elementary education is the last thing, and not the first, upon which 'economy' should be exercised."

DOWN to the war year Germany was producing more crucible steel than electric steel, but in 1915 the output of the latter exceeded the former by 30,000 tons, and in 1917 by 100,000 tons. The high-grade steel for the German helmets, mine-throwers, protective shields, aeroplane and submarine parts was produced from electric steel.

MANY engineering uses are now being found for what is known as "electrolytically deposited iron." The process of deposition is similar to the familiar one of electroplating, iron being deposited instead of silver. Worn parts of machinery can be repaired by depositing iron upon them and afterwards hardening the deposited metal by heat treatment.

THE SECRETARY OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH announces that the Research Association for the Cast Iron and Allied Industries has been approved as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The Association is to be registered as non-profit-sharing.

HUGO STINNES, reports the Bolshevik *Rabotchi Golos*, has started negotiations with the Moscow Council of National Industry for a concession for the Briansk Iron and Steel Works, one of the greatest metal concerns in Russia, on condition of the Soviet's guaranteeing a sufficient labour supply and giving him freedom to deal freely with his workmen.

THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND will hold the annual show at Derby on Tuesday, June 28, to Saturday, July 2, 1921, when £13,379 will be offered in prizes in the various sections. All applications must be addressed to the secretary at 16, Bedford Square, London, W.C.1, and intending exhibitors are advised to make early application for the necessary entry forms.

BY agreement between the Mersey Docks and Harbour Board, the Liverpool Steamship Owners' Association, the Master Stevedores' and Master Porters' Association, and the United Trades' Association of Liverpool, the cost of loading goods into railway wagons by master porters on the Dock Estate has been fixed, such costs varying with the schedule of master porters' rates for the time being.

A MEETING in Manchester last week of the North-Western Centre of the Institution of Electrical Engineers was addressed by the president, Mr. Llewellyn B. Atkinson, of London, who said the Institution had developed remarkably within the last few years, and claimed to represent a science and an industry based upon that science, and it had among its members men capable of dealing with any scientific or industrial problem relating to their profession.

IN a paper read recently at a meeting of the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen, Mr. John Holloway emphasised the importance of making a correct choice of metals for the different parts of Diesel engines, particularly with regard to iron used for the piston, cylinder liner, and cylinder head castings. The paper also laid stress on the importance of the high-class machine tools and fine measuring instruments required.

THE directors of the Associated Smelters, Melbourne, announce that the Sulphide Corporation have placed their reserve smelting capacity at the disposal of the Port Pirie Company temporarily. The smelting portion of lead concentrates is equal to 600 tons weekly.

IN the recent award made by the Industrial Court, under the provisions of which riveters in the Tyne, Wear, Tees, and Hartlepools districts are granted an increase of remuneration for "oil-tight" riveting, the payment is to date back to January 1, 1921.

IN connection with the working men's memorial of gratitude to Sir Robert Peel, the Committee of the University of London, University College, give notice that they are about to purchase books, maps, or other aids to knowledge for distribution to libraries, mechanics' institutions, reading rooms, or other similar institutions maintained by persons of the working class and receiving no grant in aid from public or municipal funds. Applications must be addressed to Mr. John Wilks, University College, London, not later than February 28.

A DISPUTE which affects several hundreds of workmen is at present in progress between Sidney Flavel & Company, Limited, Eagle Foundry, Leamington, and their employés. Messrs. Flavel, in a letter which they have circulated to their employés, state it is impossible for them to compete in the market at the present high prices and give their workmen full-time employment, and they are not agreeable to working short time at a loss. The reductions in the wages suggested are 12½ per cent. below present rates. The men have rejected the firm's offer, and matters are for the present time at a deadlock.

ON Thursday, February 10, a most successful dinner and concert was held at the King Edward the Seventh, Corporation Street, Birmingham, to commemorate the 100th anniversary of the establishment of Thos. Clive & Son, Staniforth Street. A presentation was made to the directors, Messrs. Clive Brooke and Geo. Russell, in token of appreciation of their efforts to improve working conditions and financial position by the staff and employés. Mr. J. W. Haydon (Staffs.) made the presentation, and was supported by Mr. H. Ashton and Mr. F. Newcombe on behalf of the foundry and other workers. Mr. Clive Brooke and Mr. Geo. Russell returned thanks.

THOMAS ALLAN & SONS, LIMITED, pipe and general ironfounders, of Bonlea Foundry, Thornaby-on-Tees, have recently erected a club for their workmen under the name of the "Bonlea Foundry Workmen's Club." The building is situated in Glasgow Street, Thornaby-on-Tees, and is of handsome appearance, while the inside measurements are 120 ft. × 25 ft., containing a billiard room with three tables, a games room, a news room, and a range of bathrooms and lavatories, the whole being heated from a central heating plant erected by the company. The club contains a library of technical and other books, and a refreshment bar, which is run on temperance principles, while adjoining the building is a green allotted to the summer game of quoits. The club is much appreciated by the workmen, and is managed by a committee representing them and the company.

NEW MASONIC LODGE FOR METALLURGISTS.—A new Masonic Lodge has been consecrated at Birmingham primarily for members of the metallurgical profession, and is said to be the only Lodge of its kind in the world. The ceremony was carried out by Col. W. F. Wyley, D.L. (Prov. Grand Master of Warwickshire), assisted by Rev. Canon C. W. Barnard (Deputy Prov. Grand Master), in the presence of a large number of Masons from various parts of the country and abroad. The new Lodge is called "Prometheus," after Prometheus, who was the inventor of many arts, particularly those of working in metals and clay, and all the founders are members of the Birmingham Metallurgical Society. After the ceremony Wor. Bro. S. J. Pile was installed the First Master, who invested the following officers:—I.P.M., Wor. Bro. E. Adamson (Sheffield); S.W., Wor. Bro. S. J. Fenton; J.W., Bro. T. Vickers; Sec., Wor. Bro. F. J. Cook; D.C., Wor. Bro. E. J. Wood; S.D., Bro. J. E. Fletcher (Dudley); J.D., Bro. H. M. Ridge (London); I.G., Bro. F. J. Pike; Almoner, Bro. F. J. Hooper; Treasurer, Wor. Bro. A. Phipps.

Company News.

Bristol & South Wales Railway Wagon Company, Limited.—The annual general meeting of the shareholders of the Bristol & South Wales Railway Wagon Company was held at Bristol on the 9th inst., Colonel H. Cary Batten presiding. The chairman, moving the adoption of the report, said that, in spite of the difficulties and complications, they had a disposable balance of over £16,000, which was sufficient to provide a 10 per cent. dividend—a rate which the company had paid for over sixty years. There was £1,407 left to be carried forward. Their contingent fund, built up out of part profits, amounted to £65,000. There was good business offering just now, and additional capital could be profitably employed.

Pullman Company, Limited.—Dividend of 2 per cent. ($2 per share), less tax, on capital stock for quarter.

Parsons Marine Steam Turbine, Limited. — Interim dividend of 7½ per cent. actual, free of tax

British Hydraulic Foundry Company, Limited.—Dividend of 15s. per share, free of tax, making 20s. per share.

Ropner Shipbuilding Company, Limited. — Interim dividend of 3d. per share, less tax, on ordinary on account of current year, and dividend of 4 per cent., less tax, on 8 per cent. cumulative preference for half-year to December 31, 1920.

Birmingham Railway Carriage & Wagon Company, Limited.—Report for 1920 states that, after charging interest on debentures and dividends paid, there remains £90,474. Final dividend of 1s. per share, free of tax, on 698,231 ordinary shares of £1 each is recommended, placing to reserve £2,725; write off depreciation of buildings, plant, etc., £10,000, carrying forward £39,837.

Laminated Gears, Limited.—After paying debenture interest, etc., profit for past year was £2,340. Dividend of 5 per cent. recommended. £760 forward.

Ludlow Brothers (1913), Limited.—Profit for 1920 after providing for excess profits duty amounts to £14,825, and £14,464 was brought forward. Dividend on ordinary of 1s. per share, free of tax; bonus on ordinary of 6d. per share, free of tax; reserve account, £5,000; carry forward (subject to directors' fees), £14,269.

National Gas Engine, Limited.—Dividend of 9d. per share on ordinary, less tax, same as a year ago; bonus of 9d. per share, free of tax, against 1s. per share a year ago.

Northumberland Shipbuilding Company, Limited.—No further dividends recommended; £101,346 forward. Interim at rate of 10 per cent. paid in December last.

Henry Bessemer, Limited. — Directors recommend dividend on ordinary of 5 per cent., making 10 per cent. for year, less tax.

W. T. Henley's Telegraph Works, Limited. — The directors have declared a final dividend on the ordinary shares of 2s. per share, less tax, making 3s. per share for the year.

Brown Bayley's Steel Works, Limited.—Accounts of Brown Bayleys Steel Works to December 31, 1918, show divisible balance, after deduction of interim dividend of £36,349, and after payment of preference and ordinary dividends for 1918, and writing £5,979 off preliminary expenses, there is a balance of £16,632 to be carried forward.

North Central Wagon Company, Limited. — The directors have declared an interim dividend for the past half year at the rate of 12 per cent. per annum.

Bruce Peebles & Company, Limited.—Profit for 1920, including interest and transfer fees, and after deducting income tax, administration expenses and debenture service, was £74,714, plus £5,461 brought in, making £80,175. There has been applied to reserve for excess profits duty and corporation tax £35,000, to depreciation reserve £8,000, to general reserve £10,000, leaving £27,175. Dividends on ordinary shares at 10 per cent. per annum, less tax; carry forward, £5,822.

Thomas Downie, Limited. — Capital £5,000 in £1 shares, to take over the business of marine, consulting, mechanical and electrical engineers, patentees and manufacturers, carried on at 60, Castle Street, Liverpool, and elsewhere, as "Thomas Downie." The first directors are: D. Brown, E. J. Walker, and J. S. Chadwick. Secretary: J. S. Chadwick. Registered office: 5, Castle Street, Liverpool.

Fredk. A. Power & Sons, Limited.—Capital £50,000 in £1 shares (10,000 8 per cent. cumulative preference), to take over the business of wire drawers and manufacturers of and dealers in iron and steel wire carried on by F. A. Power and E. A. Power at the Midland Iron and Steel Wire Mills, Saltley, Birmingham, as Fredk. A. Power & Son. First directors: F. A. Power (permanent), E. A. Power, C. F. Power, and G. F. Power. Registered office: Midland Iron and Steel Wire Mills, Metropolitan Road, Saltley, Birmingham.

Obituary.

MR. T. R. DOWSON, of South Shields, who died last week, had been a member of the Town Council for 23 years. He conducted a successful ship repairing business at Tyne Dock, and was very well known in shipping circles.

MR. JOSEPH BULLOCK, who was one of the original members of the Institution of British Foundrymen, has died, and at the February meeting of the Birmingham Branch, a resolution of sympathy with the deceased's family was passed.

THE death is reported, at his residence, Hudson House, Tyne Dock, of Mr. John Michael Hicks, a former dock superintendent of the North-Eastern Railway Company. Mr. Hicks, who had attained the advanced age of 86 years, had completed 57 years' railway service prior to his retirement in August, 1905.

Personal.

MR. HENRY HILTON NORMAN, late of Bromley Road, Catford, S.E., secretary of the Grand Trunk Railway Company of Canada, who died on December 20, aged 71, left estate of the gross value of £42,576, with net personalty £41,848.

A PRESENTATION was made on Saturday evening last at the offices of the Midland Counties Trades' Federation, Dudley, to Mr. T. H. Simmonds, late manager of Messrs. Bullers, Limited, Tipton. It was subscribed for by the employés of the firm, as a mark of their appreciation of their late chief.

MR. A. S. PURDON, J.P., at a social gathering of officials and foremen of the Irvine Shipbuilding Company, Limited, held at the Masonic Hall, West Hartlepool, was presented with a solid silver tea and coffee service and salver suitably inscribed, on the occasion of his retirement from the managing directorship of the company, a position he had held for 24 years.

MESSRS WILBRAHAM & SMITH, tinplate, iron and steel merchants, 8, Laurence Pountney Hill, Cannon Street, E.C.4; warehouse, 107, Upper Thames Street, E.C.4, announce that they have taken over the goodwill of the home trade, with the warehouse and stocks therein, of Messrs. Charles Hatton & Company, Limited, 5, Fen Court, and 107, Upper Thames Street, London, E.C. Both partners of the firm have previously had a very long experience in the metal trade with Messrs. Charles Hatton & Company.

British Industries Fair.

The Constructional Engineering Company, Limited, makers of modern foundry plant, Titan Works, Charles Henry Street, Birmingham, are exhibiting at Stand No. 424 a range of foundry plant and equipment all of their own manufacture, which includes:—

Cupolas.—The bottom section of a No. 2 cupola showing tuyeres and safety tuyeres. This cupola is fitted with Wood's patent air belt. No. 6 cupola bottom section is only mounted on columns. These bottom sections are shown as being very suitable for export. The remainder of the cupola can be readily built up in most works abroad, considerable saving of freightage is therefore made.

Cupolettes.—A complete and self-contained melting plant is shown. This consists of Wood's patent belted cupolette complete with drop-bottom, mounted on frame work, fitted with staging and direct coupled fan and motor. The staging is covered with roof, and the whole forms a complete and self-contained unit. The melting capacity of this cupolette is 30 cwts. of metal per hour. There is also shown one of their improved type cupolettes of the design which has been so successful, and of which nearly 200 are in use. This plant is complete with belt-driven fan.

Ladles.—A striking feature of this exhibit is a 15-ton capacity ladle and a 28-lb. hand ladle, side by side. Between these sizes there are 30 or 40 ladles shown consisting of geared, bottom-pouring, bogie ladles and swivel tilting ladles, besides a complete range of pressed steel ladles from 28 lbs. to 15 cwts. capacity.

Sand Mill.—A sand mill of improved under-driven type, fitted with plain and cogged roller, is shown.

Air Receivers.—Air receivers illustrative of their manufactures in this direction are also shown complete with all fittings.

Core Stoves.—An all-steel core-drying stove—double cased—is also shown. This is a gas-fired stove. Additional to the above there is a fairly large range of foundry requisites, including bellows, spades, riddles, sieves; in fact, everything for the use of the moulder.

The company also direct attention to a special pamphlet they are issuing in connection with the exhibition, and will be pleased to forward invitations giving admission to the Fair to any readers of THE JOURNAL interested in foundry trade matters.

XUM

IRON AND STEEL MARKETS.

Pig-Iron.

The position in pig-iron markets generally discloses few indications of an early improvement in the conditions now governing the trade, which continues practically idle in every direction, with scant encouragement to anticipate favourable development in the near future. Reports from the Clydeside districts repeat the story of lifeless markets and diminished demand for Scotch pig, with a steady and unchecked accumulation of stocks in makers' yards, for which, at present, there appears to be a restricted outlet at home and abroad. Price movements at Glasgow indicate, however, a weaker tendency, and values for the time being may be regarded as practically nominal, with No. 1 quoted £11 15s. and No. 3 and hematite at £11 10s. In the absence of fresh orders coming to hand shortly it is stated that several of the Scottish ironmasters contemplate damping down some of the furnaces. In Lancashire, conditions in the pig-iron trade are again disappointing, the high prices maintained by the coke makers being held mainly responsible, and failing some relief in this direction there will, it is feared, be no alternative but to suspend production at furnaces until costs can be reduced within reasonable limits. As an all-important factor in this direction is concerned with the wages question, it is interesting to note that the sliding scale adjustment only applies in two cases of a reduction of blast-furnace workmen's wages, during the present year, the Lincolnshire 6½ per cent. and Scottish Iron Trade Board 7½ per cent., while increases have been granted in the case of Cleveland, 6¾ per cent., and Northamptonshire 12¼ per cent. In the Manchester market the price of common No. 3 pig iron is still very uncertain, and it is evident that some buyers do very much better than others. The fact that there is now plenty of Cleveland iron to be had at £9 15s. on trucks, however, prevents any more extravagant price from being obtained in this market. The depression under which the Cleveland iron market is suffering is, if anything, accentuated, home demands showing a decrease, while the export trade is practically at minimum proportions. In the meantime, Continental competition continues active, pig-iron now being landed in Tees-side ports at something like 160s. per ton, delivered at works, a price impossible to makers of much higher costed material. Buying on home account, meantime, is almost suspended, consumers holding off in anticipation of prices shortly reaching still lower levels. Cleveland ironmasters held another meeting last week, but decided that no further price concession was practicable at the moment, nor can be possible until a further substantial reduction in production costs can be effected. There has been no further addition to the number of furnaces put out of operation so far, but unless an early improvement in demand is experienced decreased production is unavoidable. In pre-war times makers were always provided with an alternative to surplus stocks of iron by depositing the excess in the warrant stores, which, it is admitted, had its advantages as well as its drawbacks. But this remedy for over-production is no longer available to the trade, although it is contended in some quarters that the re-establishment of a warrant market would be an assistance to those who have to take contracts involving the supply of large quantities of iron over an extended period. Current quotations for home consumption, with a premium of 5s. per ton for export, are unchanged at: No. 1 and silicious, £10 per ton; No. 3 G.M.B., £9 15s.; No. 4 foundry, £9 14s.; No. 4 forge and mottled, £9 12s. 6d.; white, £9 10s. In the Birmingham market this week Derbyshire forge has dropped to £9 10s., and No. 3 foundry to £10, representing 25s. to 30s. reduction on last week's rate, but business has not been stimulated. There are really no Northamptonshire quotations, sellers rather inviting offers. South Staffordshire forge was offering at £10 10s., and No. 3 at £11, delivered. The cuts made had no effect in stimulating business. Consumption has shrunk tremendously.

Business in the hematite market continues quiet and uneventful, only a limited demand existing for home consumption, with a small inquiry on overseas account. There has been no further downward movement in the direction of lower prices, and quotations are unaltered, No. 1 being 222s. 6d., and East Coast mixed numbers 220s., both for home consumption and export. In North Lancashire and South Cumberland there is no change to note in the general position of the hematite trade since last week. Business is almost at a standstill and there are no signs of any immediate revival. Rates are considerably lower than was the case three months ago, but buyers are not coming forward, a still lower level in prices being anticipated. Makers are quoting £11 per ton net f.o.t. for parcels of mixed numbers of Bessemer iron, with special brands at £12 10s. to £13 per ton net. The four furnaces at Barrow remain actively employed, and will continue so until the end of March, and then the position may have improved, but for the time prospects are depressing.

Ore.

Transactions in foreign ore at Middlesbrough are again on a very contracted scale, most consumers being overstocked, and until there is a revival of demand for pig-iron trade must remain at its present quiet level. Meantime, the freight, Bilbao-Tees, keeps to the low average of 9s., which makes best Bilbao rubio round about 40s. per ton, ex-ship Tees. In West Cumberland the demand for hematite iron ore is only fair. The Furness mines are at work, some on full and others on half time, and on Monday the mines of the Hodbarrow Company came into operation again to fulfil a pressing demand. Raisers of ore have no intention of running up stores of ore owing to the existing high costs. Quotations for native ores rule at 52s. 6d. to 70s. per ton net at mines, and Spanish ores at 42s. 6d. per ton, delivered. At Tyne Dock last week the "Levenpool" from Algiers, brought 8,080 tons for Palmers, Jarrow; the "Kassiani," from Algiers, 1,400 tons; the "Achuri," from Algiers, 3,700 tons; the "Muristan," from Benisaf, 4,500 tons; and the "Marquis de Chavarri," from Bilbao, 4,300 tons for the Consett Iron Company, Limited.

Scrap.

Stagnation continues unrelieved in all sections of the scrap markets, with little apparent prospect of any early revival of an active buying movement in the various markets. Typical of this tendency is the depressed condition of the trade in scrap material in South Wales, the bulk of this metal consumed in the district being utilised for steel sheet and tinplate bars, for which at present demand is unusually slow, and lower prices are again ruling. Heavy steel scrap is now £4 10s. to £5 10s.; bundled steel scrap and shearings, £3 15s. to £5 10s.; steel turnings, £4 to £5; mixed iron and steel scrap for basic furnaces, £2 to £5; heavy cast iron in furnace sizes, £6 to £7; and good machinery scrap, £9 to £10 delivered. Other markets are equally quiet

Steel.

Reports from all centres of the steel-producing industry indicate a continuance of the depressing conditions previously outlined in these columns, and so far without any immediate prospect of improvement. In Scotland some large concerns are said to be very badly off for orders, and though resorting to short time have great difficulty in maintaining even partial employment. Price reductions have not brought any increase in business, and buying generally is of a very meagre nature owing to the fact that it is expected that in face of foreign competition local makers will be forced to cut their prices still further. At Clydeside steel works conditions are very stagnant, and prices decline gradually, though an effort is being made to maintain values so long as costs of production remain as at present It is reported that a Clyde shipbuilding firm, as a result of negotiations with a shipowning concern, offered to build a vessel at £15 per ton, but shipowners are holding out for much less. Inquiry for steel rails is fair, but many orders are passing to Belgian makers. Engineering shops are generally going slow. At Sheffield no improvement can be recorded in the staple trade of the district, many of the works only operating on stock lines, while others are either out of commission or employed part time. The continued abstention of buyers of Sheffield steel at this particular period of the year is almost unprecedented in the trade and even with the numerous price reductions effected of late it is increasingly difficult to obtain orders to any substantial extent. There is, however, a certain amount of business passing in the higher qualities of Sheffield steel, for which no substitute can be found, but in the ordinary branches of the industry "nothing doing" is a familiar quotation At present these conditions also apply in the case of railway material, at one time almost a monopoly of Sheffield manufacturers, makers of axles, tyres and springs suffering from the general inactivity of the industry. This may be probably due to the high costs of production as compared with Continental manufacturers. Germany, for example, with a much lower scale of labour remuneration, being in a position to undercut British manufacturers, even in the home markets. South American railways, also for many years extensive buyers of this class of material from British makers, are now, it is understood, placing their orders in Germany. The fact that our late enemy can quote something like £20 per ton below the home prices giving them an exceptional advantage in the market. Some interesting details of production are

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.
CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. *Telegraphic Address: "Steel, Glasgow."*

Makers of

EFFICIENT FOUNDRY PLANT

WE INVITE YOU TO VISIT STAND 424

at

British Industries Fair
BIRMINGHAM
Feb. 21st to March 4th

THE
CONSTRUCTIONAL ENGINEERING
CO., LTD.,
Titan Works, Charles Henry Street,
BIRMINGHAM.

Air Receivers,
Cupolas,
Cupolettes,
Core Stoves,
Foundry Ladles,
,, Requisites,
Hoists,
Moulding Machines and Boxes,
Runways,
Sand Mills,
Shaking Barrels,
Sand Conveyors.

GEORGE JONES, Limited,

ESTABLISHED, 1803.

LIONEL STREET FOUNDRY, BIRMINGHAM.

Complete Rolling Mills for all Metals.

Machinery for Making Tubes and Wire.

MILL GEARING OF EVERY DESCRIPTION.

provided in the latest monthly bulletin of the National Federation of Iron and Steel Manufacturers, which contains complete figures of the outputs of iron and steel in the United Kingdom for the year 1920. With regard to the steel figures, the total for 1920 was 9,056,806. This figure has only twice been exceeded, namely, in 1917 and 1918, and it is possible that, but for the coal strike, production in 1920 might have exceeded the record total of 9,716,544 tons produced in 1917 The biggest steel-producing district in 1920 was Scotland, which was responsible for 22.9 per cent. of the country's output, but this is closely followed by the North-East Coast and South Wales, which produced 21.0 per cent and 20.5 per cent. respectively. At the Barrow steel works the Siemens department and the foundries were started again last week, and later the big mill, which had been standing since before Christmas, was put in operation. How long it will run is not known at present, but contracts held should keep it well employed for a few weeks at all events. The demand for steel is very quiet all round. Steel prices have this week been reduced 30s. to £2 per ton.

Finished Iron.

There has been, so far, no signs of improvement in the finished iron trade, most makers in the various localities in which the industry is centred reporting almost a standstill as far as fresh business is concerned. In the meantime, even the most favoured manufacturers are finding difficulty in keeping works fully going, and though some makers of marked bars are still able to maintain mills fully or partially in operation, producers of the lower grade material are badly placed with regard to specifications. The home demand is now at a very poor average compared with this time twelve months ago, while export business has dwindled to a negligible quantity, owing to the adverse exchange conditions now existing practically in all centres of trade abroad. In South Staffordshire the pressure of Continental competition in unmarked bars has had a disturbing effect upon trade, and it is reported has had the result of inducing some mills to break away from the Federation; makers, in order to retain their connections, by granting concessions to obtain orders that would otherwise go to Belgium or Germany. Ironfounders are also adversely influenced by the present conditions An announcement has been issued that Sheffield foundries have decided to make a reduction in the price of iron castings by 30s. per ton, a movement likely to be followed generally in the near future. The imports of iron, steel, etc., at Hull from abroad during the past week were:—Iron: Pig, 517 tons (Bleasdale & Company); 47 tons (Ellerman's Wilson Line), 50 tons (Wilson's and N.E.R. Company): bar, 436 tons (Bleasdale & Company); 8 tons (Ellerman's Wilson Line); 95 tons (Wilson's and N.E.R. Company); rails, 187 tons sheet, 22 tons (ditto). Steel: 138 tons (Furley & Company); 97 tons (Ellerman's Wilson Line), 135 tons (Wilson's and N.E.R. Company); 13 tons (T. Firth & Company).

Refractories.

Orders for refractory materials have been more plentiful recently, and there is a little indication of improvement in business this week. The demand for silica bricks and ganister are only moderate, but for basic materials, such as magnesite and magnesite bricks, the demand is constant. Supplies of magnesite from abroad are plentiful The crucible steel trade in Sheffield and district remains very slack. Refractory materials manufacturers are holding good stocks of all materials and can deliver promptly. Prices are weakening where users are placing contracts for supplies ahead; though, generally speaking, there is no change in the prices quoted in our last issue.

Tinplates.

The wave of depression which has overtaken the tinplate trade during the past few months has been if anything further accentuated, some twenty thousand tinplate and steel workers being reported idle in South Wales owing to the "slump." According to the sliding scale, a 30 per cent. drop in wages, when work is resumed, will be caused by the fall in prices. It is stated that only about 30 per cent. of the mills are now operating, and the feeling is growing that the curtailment of output must have a strengthening tendency sooner or later. At the same time, the stocks are not being absorbed very rapidly, and it is calculated that there is £5,000,000 worth of tinplates at South Wales docks waiting to be shipped abroad. Wasters are quiet, and quarters are offered at 20s. f.o.t. Ternes are steady at 33s. basis f.o.t., which is slightly less than has been ruling of late. Inquiries from abroad are again absent, but it is reported that consumers are now dipping into their stocks of oil sizes. American advices show no improvement in that quarter, only about 50 per cent. of the mills capacity being in operation. Appended are the latest prices:—Cokes, 20 × 14, 32s. 6d., 34s.; ditto quarters, 35s., 36s.; cokes, 20 × 10, 47s., 49s.; ditto, 28 × 20, 62s., 70s.; ternes, 28 × 20, 66s., 68s.

Metals.

Copper.—The week's markets for copper opened with a distinctly easier tone, consumers both at home and on the Continent evidencing only a languid interest in movements in this metal. The demand for standard for early dates was less insistent than has been the case of late, and values indicated a weakening tendency. On forward account more interest was taken in April deliveries, but business on the whole was of limited extent. Refined electrolytic was a shade easier, and with wire bars closed lower on balance. Closing prices:—Cash: Wednesday, £72 5s.; Thursday, £73 5s.; Friday, £73 5s.; Monday, £72 5s.; Tuesday, £70 15s. Three Months: Wednesday, £71 12s. 6d.; Thursday, £71 10s.; Friday, £73 5s.; Monday, £72 5s.; Tuesday, £69 17s. 6d.

Tin.—In the absence of Eastern advices, the market for tin opened quietly, with Straits on offer at a premium of £20 over standard. Soon after opening, movements developed an easier tendency, a fall of 40s. from Friday's closing rates of £174 being recorded, while a similar figure was quoted for three months. Demand was, however, restricted, the market showing plainly the effects of the slump in the tinplate trade, and though sellers were offering fairly liberally, the resultant business was comparatively unimportant in volume. April deliveries were done at £173 to £173 10s., May £174, with English ingots closing 60s. lower at £166. Closing prices:—Cash: Wednesday, £163; Thursday, £168; Friday, £173 10s.; Monday, £169; Tuesday, £170. Three Months: Wednesday, £167 10s.; Thursday, £172; Friday, £173 10s.; Monday, £173 10s.; Tuesday, £173.

Spelter.—Some improvement may be noted on last week's closing prices for spelter, but values still remain at exceptionally low levels, and business continues quiet. The settlement price is marked at £25 10s., a figure at which sales have been booked for March dates.

Lead.—The tendency in this metal is again weak, with sellers offering freely, affecting both near and forward business. March sold at £20 7s. 6d. to £20 5s., and April at £20 7s. 6d., with English rather lower at £21 10s.

SUBSTITUTES REFUSE, OR YOU STAND TO LOSE. 3
"LINICORE"
Write for Sample and Money-saving quotation to
BARTOLINE (HULL) LTD.,
OIL REFINERS, HULL.

"NETHERTON" BAR IRON.
Sole London Stock Agents:—
CLARK HUNT & CO., LTD.,
Middlesex Iron Works,
SHOREDITCH, E.

DO YOU REQUIRE CASTINGS From 1 cwt. to 2 tons each?
The NORTHGATE IRONWORKS Co.
(Proprietors, R. Boby, Ltd., Associated with Vickers, Ltd.),
RAIL SIDING, BURY ST. EDMUNDS, SUFFOLK.
Finest Modern Foundry in the Eastern Counties.
Speciality: MACHINE MOULDING.
PROMPT DELIVERIES.
Telegrams: "Castings," Telephone: No. 3, Bury St. Edmunds.

Telegrams : "THROWER, GLASGOW." Telephone : 5909 CENTRAL.

ALBERT SMITH & Co FOUNDRY ENGINEERS. TOOLS & EQUIPMENT

Head Office: **60, ST. ENOCH SQUARE, GLASGOW.**

SAND BLAST EQUIPMENT. For Any Service.

MOULDING MACHINES. Electric, Air & Hand Power.

FORCED DRAUGHT. Core Stove, Furnaces.

PORTABLE CORE OVENS.

CORE MACHINES. Core Compound. Core Oil. Glutrin. Parting Powder. Perforated Chaplets, Etc.

BRASS RECOVERY MACHINES. New Process.

...TRADE... SIROCCO ...MARK...

CENTRIFUGAL FANS

For Supplying Blast to

Cupolas and Forge Fires.

Made in a large variety of sizes and suitable for pressures up to 30-in. W.G. The Fans have cast iron casings and the belt driven type are fitted with Ball Bearings.

Send for particulars to :—

DAVIDSON & CO., LTD.,

Sirocco Engineering Works, Belfast.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	70	15	0
Three months	69	17	6
Electrolytic	75	0	0
Tough	73	0	0
Best selected	73	10	0
Sheets	122	0	0
India	122	0	0
Wire bars	76	10	0
Do. Mar.	75	10	0
Do. April	75	10	0
Ingot bars	75	0	0
H.C. wire rods	83	10	0
Off. aver. cash, Jan.	71	1	4⅜
Do. 3 mths., Jan.	71	9	4⅝
Do. Settlement Jan.	71	0	2⅝
Do. Electro, Jan.	80	3	1½
Do. B.S., Jan.	77	13	9
Aver. spot, copper, Jan.	70	19	9½
Do. Electro, Jan.	81	3	8¾
Solid drawn tubes			17d.
Brazed tubes			17d.
Wire			14½d.
Yellow metal rods			9½d.
Do. 4x4 Squares			12d.
Do. 4x3 Sheets			12d.

BRASS.

Solid drawn tubes	14½d.
Brazed tubes	17½d.
Rods	13½d.
Sheets to 10 w.g.	13d.
Wire	12½d.
Rolled metal	12½d.

TIN.

	£	s.	d.
Standard cash	170	0	0
3 Months	173	0	0
English	166	0	0
Bars	168	0	0
Chinese	163	0	0
Straits	190	0	0
Australian	182	0	0
Eastern	203	0	0
Banca	195	0	0
Off. aver., cash, Jan.	190	13	11½
Do. 3 mths., Jan.	195	18	11½
Do. Sttlment., Jan.	190	10	0
Aver. spot, Jan.	190	9	6¼

SPELTER.

	£	s.	d.
Ordinary	25	2	6
Remelted	20	10	0
Hard	18	5	0
Electro 99.9	35	5	0
English	28	10	0
India	22	5	0
Prime Western	26	0	0
Zinc dust	60	0	0
Zinc ashes	6	5	0
Off. aver., Jan.	25	15	7½
Aver., spot, Jan.	25	5	5¾

LEAD.

	£	s.	d.
Soft foreign ppt	19	0	0
English	21	10	0
Off. average, Jan.	23	12	6½
Average spot, Jan.	23	7	8¾

ZINC SHEETS.

	£	s.	d.
Zinc sheets, spot	38	0	0
Do. V.M. ex. whf	39	0	0
Do. ppt., f.o.b., N.Y.			—
Dutch	38	0	0
Boiler plates	35	0	0
Battery plates	35	0	0

ANTIMONY.

	£	s.	d.
English regulus	37	5	0
Special brands	42	0	0
Chinese	24	0	0
Crude	20	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	12	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
45/50%	18	10	0
75%	28	0	0
Ferro-vanadium—			
35/40%	27/6 lb. va.		
Ferro-molybdenum—			
70/80%	7/9 lb. mo.		
Ferro-titanium—			
23/25%, carbonless	1/6 lb.		
Ferro-phosphorus, 20/23%	£49		
Ferro-tungsten—			
80/85%, carbon low	2/- lb.		
Tungsten metal powder—			
98/99%	3/- lb.		
Ferro-chrome—			
4/6% car.	£37 10		
6/8% car.	£37		
8/10% car.	£36 10		
Ferro-chrome—			
Max. 2% car.	£86		
Max. 1% car.	£102		
Max. 0.75% car.	£120		
65/75%, carbonless	3/- lb.		
Nickel—99·8%, cubes or pellets	£205		
Cobalt metal—97%.	20/- lb.		
Aluminium—98/99%	£150		
Metallic Chromium—			
98/99%	7/6 lb.		
Ferro-manganese—			
76/80%, loose	£25		
76/80%, packed	£25		
76/80%, export	£26		
Metallic manganese—			
98/99%, carbonless	3/6 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	3	2
Finished bars, 18% tungsten	4	0
Scrap pieces		5d.
Turnings and swarf		3d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares 3 in. to 8 in. inclusive	4d. lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Flats under 1 in. by ⅜ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness	3d. lb.
Bevels of approved sizes and sections	6d. lb.
If in coils	3d. lb.
Packing	4s. cwt
Bars cut to length	10% extra
Scrap from high-speed tool steel—	
Scrap pieces	5d.
Turnings and swarf	3d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy Steel		4	10	0		
Bundled steel & shearings		4	10	0		
Mixed iron & steel	2	0	0	5	0	0
Heavy cast iron		6	0	0		
Good machinery for foundries		8	10	0		
Cleveland—						
Heavy steel		4	15	0		
Steel turnings		3	17	6		
Steel borings		3	15	0		
Heavy wrought iron piling		7	10	0		
Bundling scrap		7	0	0		
Cast-iron scrap		9	0	0		
Lancashire—						
Cast iron scrap		9	5	0		
Heavy wrought		6	0	0		
Steel turnings		3	15	0		
London—						
Copper (clean)		55	0	0		
Brass (clean)		35	0	0		
Lead (less usual draft)		16	10	0		
Tea lead		14	10	0		
Zinc		12	10	0		
New aluminium cuttings		80	0	0		
Braziery copper		45	0	0		
Gun metal		48	0	0		
Hollow pewter		120	0	0		
Shaped black pewter		80	0	0		

PIG-IRON.

N.-E. Coast—	
Foundry No. 1	200/-
Foundry No. 3	195/-
Forge No. 4	194/-
Mottled	192/6
Hematite No. 1	222/6
Hematite M/Nos.	220/-
Midlands—	
Staffs. common	195/-
,, part-mine forge	210/-
,, ,, foundry	220/-
,, Cold blast	360/-
,, basic	195/-
Northants forge	192/6—217/6
,, foundry No. 3	195/-
,, basic	205/-
Derbyshire forge	190/-
,, foundry No. 3	195/-
,, basic	190/-
Scotland—	
Foundry No. 1	235/-
,, No. 3	230/-
Hematite M/Nos.	230/-
Sheffield (d/d district)—	
Derby forge	—
,, foundry No. 3	—
,, basic	—
Lincs. forge	215/-
,, foundry No. 3	220/-
,, basic	187/6
E.C. hematite	233/-
W.C. hematite	236/-
All d/d in the district.	
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, foundry No. 3	—
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
,, foundry No. 3	—
Summerlee foundry	255/6
Glengarnock foundry	255/6
Gartsherrie foundry	255/6
Monkland foundry	255/6

FINISHED IRON & STEEL.

Iron—	£	s.	£	s.	d.
Bars (cro'n)	24	0	26	10	0
Angles	24	10	27	0	0
Tees to 3 united ins.	25	0	27	10	0
Nut and bolt			26	10	0
Hoops			26	5	0
Marked bars (Staffs.)			29	10	0
Gas strip			29	10	0
Bolts and nuts, ¾ in. × 4 in.			49	0	0
Steel—					
Ship plates			21	0	0
Boiler plates			28	0	0
Checquer plates			24	0	0
Angles			19	0	0
Tees			20	0	0
Channels			19	10	0
Joists			19	0	0
Rounds, ⅝ in.–3-in.			21	0	0
Rounds, 3 in.–5½ in.			20	0	0
Flats, 5 in.–8 in.			20	10	0
Flats over 8 in.			20	0	0
Rails, heavy			19	0	0
Fishplates			25	0	0
Hoops			23	0	0
Black sheets, 24 g.			24	10	0
Galv. cor. sheets, 24 g.			26	0	0
Galv. fencing wire, 8 g. plain			30	10	0
Rivets, ¾ in. dia			36	0	0
Billets, soft			13	10	0
Billets, hard			14	10	0
Sheet and tin bars			14	10	0

PHOSPHOR BRONZE.

Rolled.	Per lb. s. d.
⅛ in. to 1 in. wide	2 0½
1 in. to 1½ in. wide	1 11½
1½ in. to 2 in. wide	1 10½

Strips.	s. d.
2 in. to 6 in. to 26 S.W.G.	1 9¾
6 in. to 12 in. to 26 S.W.G.	1 9¾

Sheets.	s. d.
12 in. to 18 in. to 24 S.W.G.	1 10
18 in. to 24 in. to 24 S.W.G.	1 10¾
24 in. to 30 in. to 20 S.W.G.	1 11¾
30 in. to 36 in. to 16 S.W.G.	2 0¾
36 in. to 42 in. to 16 S.W.G.	2 1¾

Extras.

For Gauge: Any width up to 36 in. wide, ½d. per lb. per thinner gauge.

Drawn Rods.	s. d.
¼ in. to ½ in. dia. in random lengths; ⅝ in. to 1½ in. dia. in random lengths	1 10½
Over 1½ in. to 1¾ in.	1 10½
Tubes—basis price	2 0¼

Delivery 2 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

Charles Clifford & Son, Limited, Birmingham.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	1/3 to 1/9
Rolled—	
To 9 in. wide	1/10½ to 2/4½
To 12 in. wide	1/11 to 2/5
To 15 in. wide	2/- to 2/6
To 18 in. wide	2/1 to 2/7
To 21 in. wide	2/2 to 2/8
To 24 in. wide	2/3 to 2/9
Ingots for spoons and forks	1/3 to 1/9
Ingots rolled to spoon size	1/6 to 2/-
Wire round—	
3/0 to 10. G.	2/1 to 2/8

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	32.09
No. 2 foundry Valley	29.00
No. 2 foundry, Birm.	27.50
Basic	29.46
Bessemer	30.96
Malleable	31.96
Grey forge	28.96
Ferro-manganese, Atl. port	90.00
Bess. rails, h'y, at mill	45.00
O.-h. rails, h'y, at mill	47.00
Bess. billets	43.50
O.-h. billets	43.50
O.-h. sheet bars	47.00
Wire rods	57.00
	Cents.
Iron bars, Phila.	2.70
Steel bars	2.00
Tank plates	2.25
Beams, etc.	2.20
Skelp, grooved steel	2.45
Skelp, sheared steel	2.65
Steel hoops	2.15
Sheets, black, No. 28	4.15
Sheets, galv., No. 28	5.35
Sheets, blue an'l'd, 9&10	3.20
Wire nails	3.10
Plain wire	3.00
Barbed wire, galv.	4.10
Tinplate, 100-lb. box	$7.00

COKE.

Welsh foundry	72/6
,, furnace	57/6
Durham & North foundry	70/-
,, furnace	54/6
Other Districts, foundry	77/9
,, furnace	55/-

SWEDISH IRON.

	£ s. d.
Bars, hammered basis sizes ..	Basis price.
Rolled Ordinary—Assortment ..	31 0 0 to 38 0 0
Nail Rods—Square, round and flats ..	
Keg Steel } about Faggot Steel } £50	Prices nominal.

Blooms—
Single welded .. £20 to £25

Billets—
Single and double welded .. £22 to £27

Pig-Iron—
Grey, white or mottled .. £15 to £20

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

	Up to and incl. 2 in.	Over 2 in.
Gas ..	net	−5%
Water ..	+10 %	+ 3⅓%
Steam ..	+21¼%	+13¾%

REFRACTORIES.

	£ s. d.
Magnesite bricks, 2½ in., d/d	137 10 0
Do. 3 in., d/d	165 0 0
Common firebricks, 2½ in., d/d	10 0 0
Do. 3 in., d/d	12 0 0
Scotch firebricks, 2½ in., f.o.r.	12 15 0
Do. 3 in., f.o.r.	15 7 6
Sheffield quality, 2½ in., f.o.r.	11 0 0
Do. 3 in., f.o.r.	13 5 0
Silica bricks (ord.), 2½ in., f.o.r.	15 10 6
Do. 3 in., f.o.r.	18 12 6

All per 1,000 bricks.

Basic Dolomite ..	3 18 0
Dead burnt magnesite (peas and powder), d/d ..	26 0 0
Ground fireclay	1 10 0 to 2 0 0
Ganister	1 10 0 to 1 12 6

TINPLATES.

I.C. Cokes, 20×14, box	33/–
,, 28×20, ,,	66/–
,, 20×10, ,,	47/–
,, 18¾×14, ,,	36/–
Terneplates, 28×20, ,,	70/–

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£ s. d.		
Feb. 16	72 5 0	dec.	7/6
,, 17	73 5 0	inc.	20/–
,, 18	73 5 0	No change	
,, 21	72 5 0	dec.	20/–
,, 22	70 15 0	,,	35/–

Standard Tin (cash).

Feb. 16	163 0 0	dec.	145/–
,, 17	168 0 0	inc.	100/–
,, 18	173 10 0	,,	110/–
,, 21	170 0 0	dec.	70/–
,, 22	170 0 0	No change	

Zinc Sheets (spot).

Feb. 16	38 0 0	No change	
,, 17	38 0 0	No change	
,, 18	38 0 0	No change	
,, 21	38 0 0	No change	
,, 22	38 0 0	No change	

Spelter (ordinary).

Feb. 16	24 15 0	dec.	2/6
,, 17	24 12 6	,,	2/6
,, 18	25 10 0	inc.	17/6
,, 21	25 10 0	No change	
,, 22	25 2 6	dec.	7/6

Lead (English).

Feb. 16	22 10 0	dec.	10/–
,, 17	20 0 0	,,	50/–
,, 18	22 0 0	inc.	40/–
,, 21	21 10 0	dec.	10/–
,, 22	21 10 0	No change	

It is our business to
HELP THE FOUNDRY
with
WOOD PATTERNS, METAL PATTERNS AND PATTERN PLATES.
We study your moulding problems and help you to solve them. Send full particulars of your difficulties to
FURMSTON & LAWLOR, ENGINEERS, PATTERN MAKERS,
Birds Hill - LETCHWORTH.

ROBERT HEATH & LOW MOOR, LIMITED,
Stoke-on-Trent.

B.E.H. IRON.
At works.
BARS, ANGLES, TEES and PLATES.

R.H. ♔ IRON.
Delivered F.O.B. Liverpool,
BARS, ANGLES, TEES and PLATES.

HOOPS delivered F.O.B. Liverpool.

IRON
R.D. ♔
RAVENSDALE (Best)

MILD STEEL (up to 2in. wide)
Marked
"HEATH'S SOFT STEEL."

Prices on Application.

WILLIAM JACKS & COMPANY,
5, EAST INDIA AVENUE, LONDON, E.C.3.

Telegrams: ALKALIZE, BIRMINGHAM.
Telephone: CENTRAL 1175 & 1176
Birmingham Office:
18, BENNETT'S HILL.

Telegrams: ALKALIZE, LONDON.
Telephone: 7860 AVENUE (3 lines.
Head Office:
5, EAST INDIA AVENUE, London, E.C.

REGISTERED TRADE MARK
LIMPET

PIG IRON.

Scotch, Middlesbro,' Hematite, Basic, Specials, &c., &c.

TIN — SPELTER — CHROME
COPPER — ANTIMONY—MANGANESE.

WILLIAM COLVIN & COMPANY,
ROYAL EXCHANGE, MIDDLESBROUGH.
93, HOPE STREET, GLASGOW.

SITUATION WANTED.

ASSISTANT FOUNDRY FOREMAN desires position as Foreman, 24 years' experience of dry and green sand; plate and machine moulding a speciality. Also motor and intricate cored work. Could introduce mass production methods if required. First-class refs. Moderate salary.—Box 682, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, John Street, Adelphi, Strand, London, W.C.2.

MIDLAND JOBBING IRON FOUNDRY requires Working Foreman; good shop and prospects.—Write full particulars, experience, Union and wages, Box 684, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, John Street, Adelphi, Strand, London, W.C.2.

MISCELLANEOUS.

LIMESTONE, Raw for Blast Furnaces, etc. Finest Quality.—Prices from KNOWLE LIME WORKS, Presthorpe, Salop.

STRONG ERITH FOUNDRY LOAM on Rail in Truck loads.—Sample and quotation from T. C. BUCKLEY, Sand Pits, Erith.

WANTED all users of METALLIC CEMENT to buy our PEERLESS brand, which produces "Artificial Iron" 10 lb. tin 10s., free delivered.—WILLIAM OLSEN, LTD., Cogan Street, Hull.

PATTERNS and CASTINGS SUPPLIED WHICH GIVE SATISFACTION. Inquiries solicited Quotations by return of post or telephone. You can secure good-class work, reasonable prices, and promptitude in delivery by placing your orders with VIDEX PATTERN WORKS AND FOUNDRY, Huntsworth Mews, Upper Baker Street, London, N.W.1 (Telepohne, Paddington 364).

ADVICE and Handbook Free. — KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Reg. Patent Agent, 146a, Queen Victoria Street, E.C.4.

THE Standard Minerals Co. supply at lowest prices Foundry Coke, Purified Breeze, Ganister, Fire Clay and Bricks, Limestone, Spar, and Moulding Sand to suit all requirements.—THE STANDARD MINERALS CO., 136-138, Mansfield Road, Nottingham.

FOUNDRY REQUISITES.—Straw Rope, Core Gum, Core Vent, Plumbago, Blacking, Coal Dust, Riddles, Sieves, Bellows, etc. Prompt delivery. Lowest prices.—LYNDHURST MANUFACTURING CO., 25, Sherwood Rise, Nottingham.

PROMPT Deliveries of Iron Castings up to 10 cwt.
Inquiries solicited.

B. FIRMAN & COMPANY,

Iron Founders, Colliery Road, Nottingham.

Telephone 673. Telegrams: Firman, Nottingham.

MACHINERY.

FOR SALE.

Cross Compound Horizontal Corliss ENGINE, "Wheelocks" Patent, 15 in and 24 in cyls., 36 in. stroke, by D. Adamson & Co.
Two Cross Compound Horizontal STEAM ENGINES. 12½ in. and 20 in. cyls., 26 in. stroke, by Robey & Co.
Cross Compound Horizontal STEAM ENGINE, 11 in. and 17 in. cyls., 20 in. stroke, by J. Fowler & Co., Ltd.
Pair of Horizontal STEAM ENGINES, 11 in. cyls., 14 in. stroke, by Robey & Co.
One 250 ton Powerful Hydraulic FORGING PRESS, with 22 in. ram, 1,500 lbs. working pressure.
Six 150 tons Vertical Hydraulic FORGING and PIERCING PRESSES, 19 in. ram.
Powerful Hydraulic CEMENT FLAG-MAKING PLANT, by Henry Berry & Co.
Hydraulic ACCUMULATOR, 8 in. ram, 6 ft. stroke, with cast-iron dead weights.
Nearly New Worthington Horizontal DUPLEX PUMP, 16 in. × 10½ in. × 10 in.
Two Nearly New Worthington Horizontal DUPLEX PUMPS, 7½ in. × 5 in. × 6 in., with gun-metal boxes.

CATALOGUE OF STOCK MACHINERY, 5-6,000 LOTS, FREE ON APPLICATION. INSPECTION INVITED.

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.
Telegrams: "Forward, Sheffield."
Telephone: 4321 (8 lines).

MACHINERY.

HAMMOND AND BOTTOMLEY,
33, Mackenzie Street, Slough, Bucks,
METAL AND MACHINERY MERCHANTS,
Specialising in
PLANT AND MATERIAL FOR THE FOUNDRY TRADE,
beg to offer
the following Foundry Plant, etc., for immediate delivery, at Low Prices.

MOULDING MACHINES.

2 Tabor plain Squeezers for 24 in. x 18 in. Boxes.
2 Tabor plain Squeezers for 18 x 12 in. Boxes.
2 Tabor split pattern power draft Squeezers for 18 in. x 12 in. Boxes.
1 Darling & Sellars Turnover pattern plate m/c for 42 in. x 24 in. Boxes.
1 London Emery Works hand Squeezer, with stripping plate attachment.

FURNACES AND BLOWERS, ETC.

Cupola, brand new, Capacity 12-15 tons per hour, 10 ft. diam.
Roots' Blower, No. 3, by Alldays & Onions—new revolvers, etc.
1 Sturtevant Fan, 12 in. Outlets, nearly new condition.

SAND BLASTS.

Large Room Plant, room 8 ft. 6 in. sq., by Tilghmans, no compressor.
Small Vertical Plant, by Tilghmans.

1 TON LADLE, geared, by Whiting, nearly new.
2 Tons MOULDERS' SPRIGS, 2½ in. only. Price, 38s. cwt. to clear.
12 Plumbago Crucibles, 400-lbs. capacity, new, cheap.
Grinding Mill, for grinding fine coal dust, £25.

FOUNDERS PLEASE NOTE.—Our principals are practical men of wide experience in Foundry practice and modern methods and equipment. We will be pleased to quote for suitable moulding and other plant upon receipt of particulars of class of work to be produced.
Please send us your inquiries for all grades of SCRAP METALS, ferrous and non-ferrous. Lowest market prices.
We are cash buyers of modern Foundry Plant.

PLANT FOR SALE.

1 Tilting Coke Furnace, from Messrs. Green, capacity 8 cwts., with fan and electric motor if required lining included, NEW.
1 Manometer Crucible Gas Furnace, capacity 2 qrs., NEW.
6 Metallic Moulder Presses, capacity 2 ft. x 4 ft NEW.
10 Tons Malleable Pig-iron.
1 Ton Scrap Malleable Iron.
40 Gallons Whale Oil.
1 Hack Saw, 15 in., NEW.
1 Vertical Milling Machine, with only one cross-feed.
4 Centre Lathes.
1 Capstan Lathe.
1 Drilling Machine.
1 Hand Press for Bushing, NEW
1 Suction Gas Engine, 35 h.p., Hornsby.
Can be inspected at the SIMOON FOUNDRY, Twickenham, Road, Teddington.
Letters to the SIMOON ENGINEERING COMPANY, Bramber Road, West Kensington

FOUNDRY LADLE.—Wanted, a 12-13-cwt. worm-geared Foundry Ladle, top pouring, either new or secondhand.—Particulars and price to Box 678, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ADVERTISER wishes to purchase a 1-ton or 30-cwt. Electric Furnace, for steel making; secondhand equipment desired. State type and full details of plant and price required.—Reply to Box 680, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOR SALE.—Smedley Bros., type 10 Special Heavy Overgeared Solid Bottommed, 9-ft. Ganister Mill, with Stationary Pan and Revolving Hollow Cast-iron Runners. Condition almost equal to new. Prompt delivery.—Further particulars on application to THOMAS BROOKE & SONS, LTD., 28, Blonk Street, Sheffield.

FOR SALE.—5 ft. 6 in diameter Drop Bottom Cupola (Thwaites), complete with 20-cwt. Electric Hoist and Charging platform; quite new, never been used.—R RUSSELL & SONS, LIMITED, Derby.